Bayou Lafourche

Watershed Implementation Plan

Upper Bayou Lafourche Watershed • Subsegment 020401

Introduction

What is Nonpoint Source Pollution?

Nonpoint source pollution is defined as the pollution of waters caused by rainfall moving over and through the ground. As runoff moves, it picks up and carries away natural pollutants and pollutants resulting from human activity, finally depositing them into lakes, rivers, bayous, wetlands, coastal waters, and ground waters. Nonpoint source pollution is the largest cause of water quality impairment in our nation's waters. It is difficult to locate the source of this diffuse runoff and the pollution it carries. Nonpoint source pollution is not regulated by the government like discharges from industrial activities. The difficulty of source location and the non-regulatory context of implementation make nonpoint source pollution a particularly complex problem to overcome.

What is a Watershed?

We all live in a watershed. A watershed is all the land that drains into a specific river, lake, or bayou. In its natural state, a watershed is defined by the topography. Water is pulled by gravity to the lowest point and the watershed is composed of all the land that drains to that point. Watersheds provide a predicable, structured framework for the evaluation and mitigation of water quality impairments.

Why Watersheds?

Working within a watershed framework allows stakeholders to target implementation at areas that are most likely to contribute to the water quality impairments of a specific water body. By evaluating the land uses within the watershed, stakeholders are better able to formulate a complete understanding of the potential sources of impairment. This understanding promotes a comprehensive approach to addressing nonpoint source pollution. The greatest water quality improvements result when all potential sources of pollution are addressed. The watershed framework also allows funding and effort to be targeted at the areas that contribute to the impairment of a specific water body. A targeted approach increases the likelihood of water quality improvements and results in a higher return on investment from water quality funding.

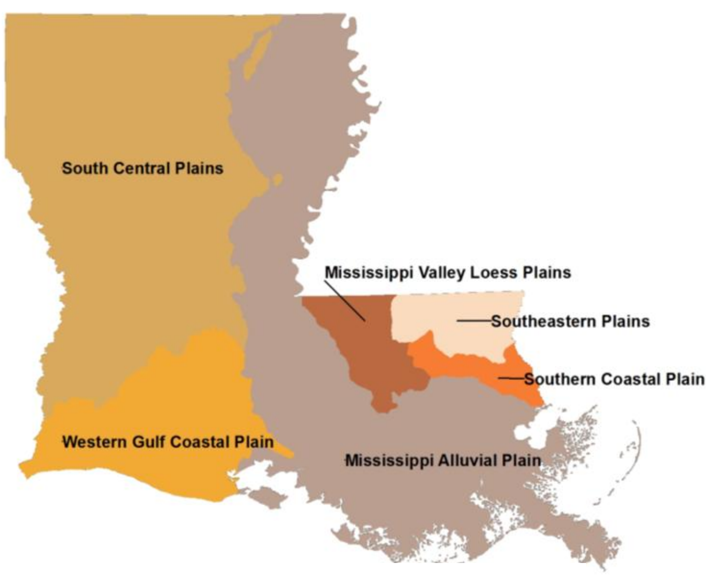
Who is a Stakeholder?

In the corporate world, a stakeholder is defined as a person or group that has an investment, share, or interest in something, as a business or industry (Dictionary.com). This definition is easily transferred to the watershed framework. In a watershed, a stakeholder's investment, share, or interest may be in the form of a favorite fishing hole, a sense of place, or a source of drinking water. Stakeholders in Bayou Lafourche include everyone who has an interest in the bayou as part of their past, present or future. Because of this interest, stakeholders may be obliged or compelled to take action to protect, enhance, or restore the function of the Bayou Lafourche Watershed.

Upper Bayou Lafourche Watershed:

Louisiana Subsegment 020401; Bayou Lafourche – Donaldsonville to the Intracoastal Waterway at Larose.

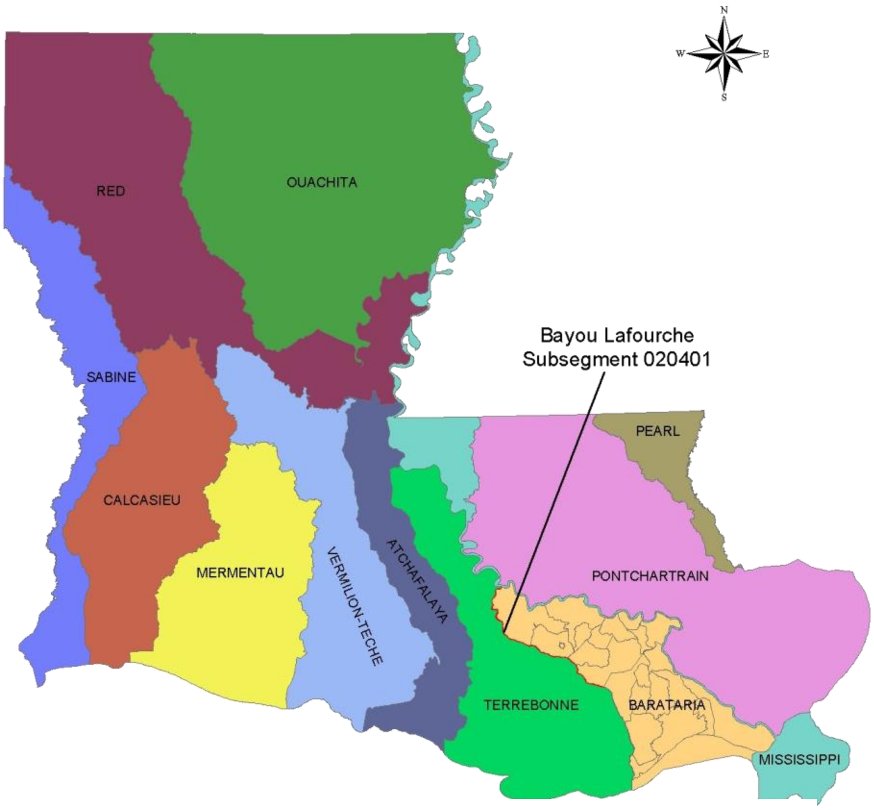
The Upper Bayou Lafourche Watershed stretches the length of Bayou Lafourche from the pumps that feed the bayou at Donaldsonville to the Intracoastal Waterway at Larose. The watershed is confined on the east and west by the natural levees of the bayou. This gives the watershed a thin ribbon-like structure, only a few widths wider than the bayou from beginning to end. The watershed covers an area of 10.66 square miles. This area may seem inconsequential, but nearly every acre of the watershed has been altered by human activity. Louisiana Highways 1 and 308 are etched into the watershed on either side of Bayou Lafourche. The watershed also includes urbanized areas of Donaldsonville, Thibodaux, Raceland, and Larose, as well as homes, businesses, sugar cane fields, pastures, and petroleum industry support activities.



Louisiana Ecoregions

Bayou Lafourche is located in the Lower Mississippi River Alluvial Plain Ecoregion. Ecoregions are areas of distinct biological and physical characteristics and have proven to be an effective aid for inventorying and assessing national and regional environmental resources, for setting regional resource management goals, and for developing biological criteria and water quality standards. The Lower Mississippi River Alluvial Plain Ecoregion contains natural levees of moderate elevation and slope; and vegetation includes both cypress forest and bottomland hardwoods. Many of the streams in this ecoregion have been hydrologically modified to improve navigation and drainage.

The Upper Bayou Lafourche Watershed forms the western boundary of the Barataria Basin. The Barataria Basin lies in the eastern coastal region of Louisiana and is bounded on the north and east by the Lower Mississippi River, on the west by Bayou Lafourche and on the south by the Gulf of Mexico. The major receiving water body in the basin is Barataria Bay. The Barataria Basin consists largely of wooded lowlands and fresh to brackish marshes, with some saline marsh on the fringes of Barataria Bay. Elevations in this basin range from minus two to four feet above sea level.



Louisiana watershed basins and Barataria Basin subsegments

The Louisiana Department of Environmental Quality is tasked with monitoring Bayou Lafourche to ensure that water quality standards are met. Water quality standards provide for the protection and preservation of the abundant natural resources of Louisiana's many and varied aquatic ecosystems; protect the public health and welfare that might otherwise be threatened by degradation of water quality; and protect or enhance the quality of public waters for designated uses. Water bodies of the State of Louisiana are assigned a set of designated uses that define the intended uses of a water body. Each designated use is associated with a set of water quality criteria that must be met to support that use. These water quality criteria form a water body's water quality standards. Bayou Lafourche is assigned the following designated uses: primary contact recreation, secondary contact recreation, fish & wildlife propagation, and drinking water source.

Bayou Lafourche has been consistently unable to meet the water quality criteria necessary to support the designated uses of Primary Contact Recreation and Fish and Wildlife Propagation. These designated uses help to ensure that water quality is sufficient to support a diverse aquatic and terrestrial habitat, and to protect swimmers from potential illness. To address these deficiencies, total maximum daily loads (TMDLs) for dissolved oxygen and fecal coliform have been developed. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs will be described at length later in this document.

This watershed management plan has been developed to help meet the nonpoint source pollution goals of the Bayou Lafourche TMDLs. It is hoped that by reducing the impact of nonpoint source pollution in Bayou Lafourche, water quality can be improved, water quality standards can be met, and designated uses can be attained. This document serves as guidance to all the stakeholders in the Bayou Lafourche watershed. By working together to mitigate the impact of nonpoint source pollution, we can improve the natural environment, increase property values, and elevate the quality of life for everyone who lives in, plays in, or passes through the Bayou Lafourche Watershed.

History

A comprehensive understanding of the impacts on the Bayou Lafourche watershed would be hard to develop without some knowledge of how man first altered the land. Few other watersheds in Louisiana have been so drastically changed from their natural state. By reviewing the history of early settlement in the region, stakeholders can be better prepared to implement the strategies necessary to repair the damage done to the bayou and return the functions that have been lost for centuries.

When European explorers first descended into Southern Louisiana in the 16th Century, Bayou Lafourche was only 500 years removed from concluding its roll as the main channel of the Mississippi River. At that time, Bayou Lafourche was a significant distributary of the Mississippi, estimated to carry 12% of the river's waters. Early explorers recognized the importance of locating an alternate route to the Gulf of Mexico to expedite trade and as an alternative to the complex delta of the Mississippi River. Europeans weren't the first to recognize the importance of Bayou Lafourche; Native Americans already inhabited the region and had erected settlements in the area surrounding the bayou. The high natural levees of the former river channel provided protection from flooding, and the rich alluvial soils were well suited for farming.

Levee construction on Bayou Lafourche circa 1900

In 1718 New Orleans was founded and a flood of immigrants began to arrive from Europe. Among these were some of the first settlers of Bayou Lafourche, the Germans. Known to the French as “les Allemands”, the Germans initially settled along the Mississippi River in the area known as the German Coast, just upriver from New Orleans (St. Charles and St. John the Baptist parishes). Many later migrated to the Bayou Lafourche region.

In 1763 the formerly French lands east of the Mississippi were surrendered to Great Britain and the Isle of Orleans and French lands west of the Mississippi were ceded to Spain. Less than a decade before, the Acadians had been forcibly removed by the British from their homeland in Nova Scotia. The Spanish welcomed the Acadian refugees as colonist on the presumption that they would aid in the protection of Spanish lands from their British neighbors. The first Acadians were forced to colonize the banks of the Mississippi River north of the German Coast, later coined the Acadian Coast (St. James and Ascension parishes). The forced colonization virtually prohibited the Acadians from reuniting with their families from which they were separated during the expulsion from Nova Scotia.

A rebellion in New Orleans against the Spanish Governor Ulloa relaxed the forced colonization and many Acadians and Germans migrated into the Lafourche Valley. These early settlers recognized the same advantages of living along the bayou as the Native Americans that had inhabited the region for centuries before: moderate flood protection and rich soils. The new settlers also utilized Bayou Lafourche as a source of fresh water and a route to the developing trading center of New Orleans.

Satellite image of development along Bayou Lafourche in Southeast Louisiana

While the high banks of Bayou Lafourche provided some protection from flooding, the bayou regularly swelled beyond its confines and spilled over the surrounding land. Early land grants charged each landowner with the task of erecting and maintaining his own levee along the bayou. The maintenance of these levees was integral to the protection of the landowner and his neighbors. The high cost and effort associated with levee construction and maintenance resulted in the cultivation of narrow farms that allowed access to Bayou Lafourche, but limited the amount of levee each owner was required to maintain. These thin ribbons of land stretched away from the bayou as the land sloped down into the swamps in the rear. As a generation of farmers passed the land to their heirs, the farms were divided from the bayou to the swamp, and the ribbon was thinned. This allowed each heir valuable access to the bayou, and equally split less valuable land near the swamps. As Acadians, Germans, Creoles, Spanish, English, and Italians continued to settle Bayou Lafourche, these ribbons continued to develop down Bayou Lafourche away from the Mississippi River. This unique form of colonization is still evident today. The ribbons of land give the area around Bayou Lafourche the distinct aerial image of a finger ominously pointing from the Mississippi River, south toward the Gulf of Mexico.

Bayou Lafourche Water Quality

The health of a water body is assessed largely by evaluating the chemical, physical, and biological characteristics of water samples. Samples results are compared to expected conditions to determine the state of wellbeing of a water body. Louisiana statute entrusts the Louisiana Department of Environmental Quality with the task of assessing the health of all water bodies of the state of Louisiana.

Designated Uses

Each water body of state is assigned a set of designated uses. The Louisiana Administrative Code defines designated use as: “a use of the waters of the state as established by the water quality standards provided in LAC 33:IX.1111.” Designated uses are designed to characterize the practical uses of a water body and to aid in the protection of those uses. There are seven designated uses for surface waters in Louisiana: primary contact recreation, secondary contact recreation, fish and wildlife propagation, drinking water supply, oyster propagation, agriculture, and outstanding natural resource waters (LAC 33:IX.1111). Of those seven, Upper Bayou Lafourche is specifically assigned four designated uses: primary contact recreation, secondary contact recreation, fish and wildlife propagation, and drinking water supply.

Primary contact recreation is any recreational or other water contact use involving prolonged or regular full-body contact with the water and in which the probability of ingesting appreciable amounts of water is considerable. Examples of this type of water use include swimming, skiing, and diving.

Secondary contact recreation is any recreational or other water contact use in which body contact with the water is either incidental or accidental and the probability of ingesting appreciable amounts of water is minimal. Examples of this type of water use include fishing, wading, and boating.

Fish and wildlife propagation includes the use of water for aquatic habitat, food, resting, reproduction, cover, and/or travel corridors for any indigenous wildlife and aquatic life species associated with the aquatic environment. This use also includes the maintenance of water quality at a level that prevents damage to indigenous wildlife and aquatic life species associated with the aquatic environment and contamination of aquatic biota consumed by humans.

Drinking water supply refers to the use of water for human consumption and general household use (see definition in LAC 33:IX.1105). Surface waters designated as drinking water supplies are identified in the numerical criteria tables; this designation does not apply to their tributaries or distributaries unless so specified.

Water Quality Criteria

Water quality sampling being conducted by LDEQ scientist

The ability of a water body to support its designated uses is determined by water quality criteria. Criteria are elements of water quality which set general and numerical limitations on the permissible amounts of a substance or other characteristics of state waters. General and numerical criteria are established to promote restoration, maintenance, and protection of state waters. A criterion for a substance represents the permissible levels for that substance at which water quality will remain sufficient to support a designated use.

Water quality criteria for the waters of Louisiana are based on their present and potential uses and the existing water quality indicated by data accumulated through monitoring programs of the department and other state and federal agencies as well as universities and private sources.

A complete list of water quality criteria can be found in Louisiana Administrative Code, Title 3, Part IX, Subpart 1, Chapter 11, Section 1113. A non-inclusive sample of numerical criteria can be found in Table 1.

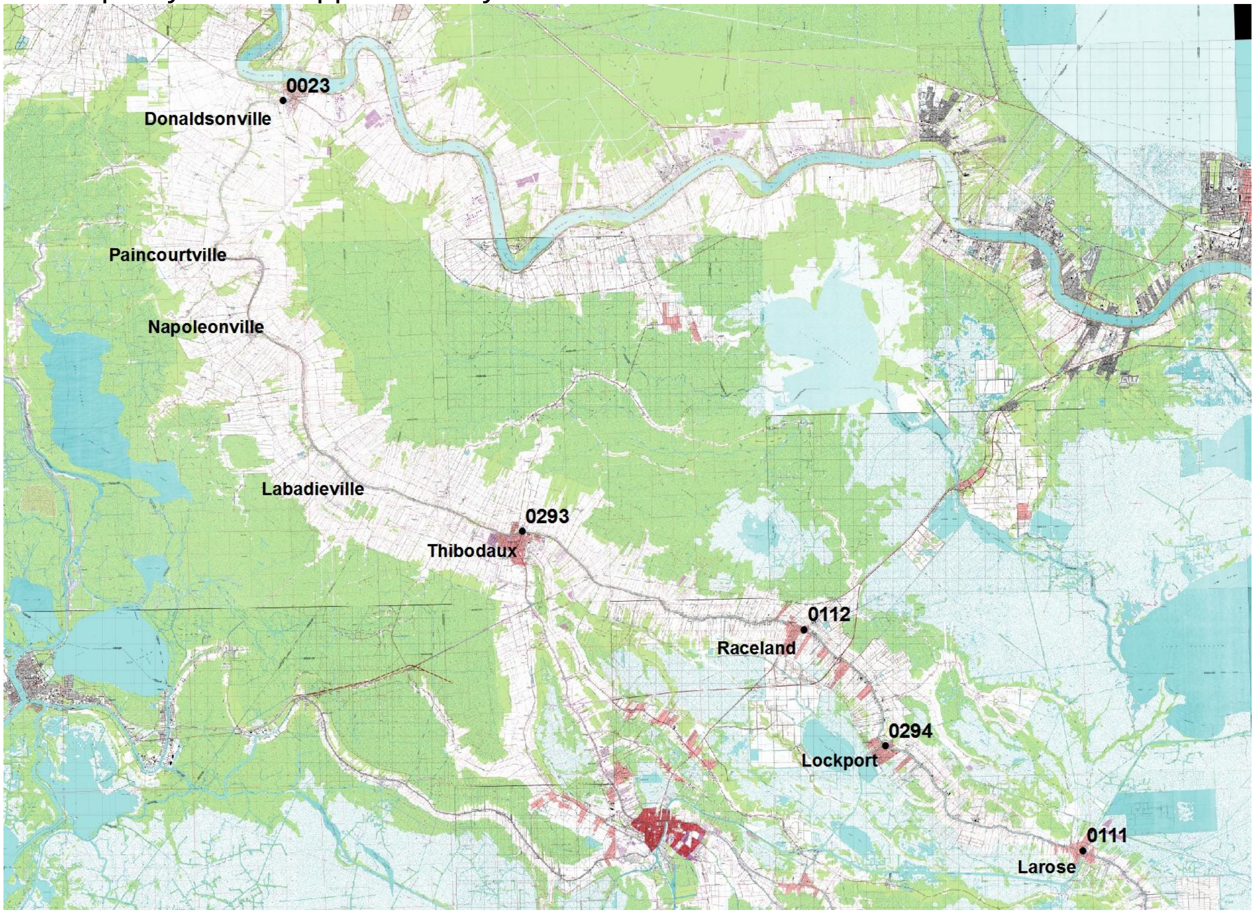
Table 1. Sample of Numerical Criteria for Subsegment 020401 (B. Lafourche)

Parameter	Criteria
Chlorides	70 (mg/L)
Sulfates	55 (mg/L)
Dissolved Oxygen	5.0 (mg/L)
pH	6.0-8.5
Bacteria	400 [a] (colonies/100mL)
Total Dissolved Solids	500 (mg/L)

[a]May 1 – October 31 (2000 colonies/100mL November 1 – April 30)

Ambient Sampling

Evaluation of water quality for attainment of criteria and subsequent support of designated uses is conducted through Louisiana's Ambient Water Quality Monitoring Program. The Louisiana Department of Environmental Quality collects ambient surface water quality data at approximately 125 sites across the state each month.



LDEQ Ambient Sampling Program water quality sampling stations on Bayou Lafourche

Over 600 monitoring sites have been established since 1958. Data has been collected at some sites since the inception of the program; however, most sites were established more recently. Not all sites are currently in use. In 1998 the department established a rotating basins monitoring program. Under this plan approximately 100 sites are selected each year for monthly monitoring. This rotational program allows LDEQ to adequately monitor the water bodies of the state with available resources. In addition, 21 sites on 16 water bodies are monitored every month of every year as long-term trend sites. One such site has been established in Bayou Lafourche below the weir at Thibodeaux. Monthly data has been collected at site 0293 since 1991. In addition to site 0293, water quality data is available from 4 other ambient water quality monitoring sites in Bayou Lafourche. These stations include:

Site 0023	Bayou Lafourche 1 mile below Donaldsonville
Site 0293	Bayou Lafourche at Thibodaux Canal Boulevard in Thibodaux
Site 1112	Bayou Lafourche at US 90 bridge in Raceland
Site 0294	Bayou Lafourche at Vacherie Street in Lockport
Site 0111	Bayou Lafourche at LA 308 bridge in Larose

A graphical representation of a selection of the ambient water quality monitoring data available for subsegment 020401 is presented in Appendix A.

An interactive data access feature is currently under development for public access to all ambient surface water quality data collected by LDEQ. Until that feature is available the public may obtain the data by contacting the LDEQ Public Records Center.

Impairments

If samples taken through the ambient sampling program fail to meet water quality criteria, a water body is considered impaired for the designated use(s) to which those criteria apply. Waters of the state are assessed biennially in the Louisiana Water Quality Inventory Integrated Report (Integrated Report). The Integrated Report includes the 303(d) list of impaired water bodies. Bayou Lafourche subsegment 020401 has been included on the 1996, 1998, 2000, 2002, and 2004 303(d) lists of impaired water bodies. Bayou Lafourche is noted as being unable to support the designated uses of primary contact recreation and fish & wildlife propagation.

The assessment of these impairments is based largely on low dissolved oxygen and high fecal coliform. Louisiana Water Quality Inventory Integrate Reports can be viewed online via www.ldeq.org.

Total Maximum Daily Loads (TMDLs)

The Environmental Protection Agency (EPA) with LDEQ as a partner has entered into a court ordered agreement to develop Total Maximum Daily Loads (TMDLs) for water bodies listed on Louisiana's 303(d) list of impaired water bodies. A TMDL is the maximum amount of a pollutant that a water body can assimilate while still maintaining the established water quality criteria. TMDLs are a tool for improving and protecting water quality in impaired water bodies. Through the TMDL, pollutant loads can be allocated to point sources and nonpoint sources discharging to the water body. Once these loads have been allocated, Louisiana Pollution Discharge Elimination System (LPDES) permits can be used to manage point source loading. Nonpoint source loading is addressed through the implementation of this watershed plan with the cooperation of local, regional, state, and federal cooperators.

TMDLs are developed through the use of computer modeling that evaluates data from various sources. The model uses water quality data to simulate pollutant loading during critical conditions (low flow and high temperatures). Model results are used to estimate the required load reductions needed attain established water quality criteria and support a water body's designated uses. Required load reductions are distributed to point and nonpoint sources and include a margin of safety (MOS).

TMDL for Dissolved Oxygen and Nutrients

A TMDL for dissolved oxygen and nutrients was prepared by The Cadmus Group, Inc.; ARCADIS G&M, Inc.; and The Louis Berger Group, Inc. for the Unites States Environmental Protection Agency, Region 6. The summary below is adapted from the fact sheet included in the TMDL document.

A water quality model (LA-QUAL) was used to simulate DO, carbonaceous biochemical oxygen demand (CBOD), ammonia nitrogen, and organic nitrogen in the subsegment. The model was set up and calibrated using intensive survey data collected on September 23, 2003, and monitoring data and other information collected by the U.S. Geologic Survey (USGS) and the Louisiana Department of Environmental Quality (LDEQ). The projection simulations were run at critical flows and temperatures to address seasonality as required by the Clean Water Act.

The projection simulation results were used to develop a TMDL for oxygen demanding substances (CBOD, ammonia nitrogen, organic nitrogen, and sediment oxygen demand [SOD]) under the following scenarios:

Scenario 1 – Current loading scenario, including all point sources, nonpoint sources, and natural background contributions;

Scenario 2 – Modified loading scenario, as necessary to meet the 5.0 mg/L DO standard, through the increase/reduction of all existing loading (point sources, nonpoint sources, and natural background contributions) until the DO standard is met;

Scenario 3 - Modified nonpoint source loading scenario, as necessary to meet the 5.0 mg/L DO standard, through the increase/reduction of all existing nonpoint source loading and natural background contributions until the DO standard is met;

Scenario 4 – Modified flow scenario, utilizing a minimum flow (Scenario 4a) to achieve the 5.0 mg/L DO standard in the extant model developed under the first three scenarios, and a projected flow of 1,000 cfs for the subsegment without the fixed weir at Thibodaux and increased cross-sectional areas due to anticipated dredging (Scenario 4b); and

Scenario 5 – Loading evaluation scenario, utilizing the extant model developed under the first three scenarios that demonstrates the relative impact of various loading through the elimination of all point source loading (Scenario 5a) and elimination of all nonpoint source loading (Scenario 5b).

Calculated Load Allocations (LA), Waste Load Allocations (WLA), Margin of Safety (MOS), and TMDLs for Scenarios 2, 4a, and 4b are presented in Table 2. The largest loading to Subsegment 020401 is the constituency of waters diverted from the Mississippi River. For purposes of this TMDL, the constituency of the Mississippi River waters is considered to be a nonpoint source loading.

All projected simulations indicated that the ambient concentrations of ammonia nitrogen (maximum concentration of 0.14 mg/L) would be below the chronic criteria as determined under the 1999 updated criteria (minimum concentration of 1.44 mg/L). The results of the model projection simulations under each scenario are summarized as follows:

Scenario 1 – Under existing loadings, the projected summer critical conditions (7Q10 flow and temperature of 30.27° Celsius [C]) and winter critical conditions (7Q10 flow and temperature of 20.80°C) maintained the 5.0 mg/L DO standard throughout the reach of the subsegment. Therefore, no load reductions will be required under this TMDL. An explicit 10 percent margin of safety was included in the TMDL calculations.

Scenario 2 – Because no load reductions were required under summer or winter critical conditions in Scenario 1 to maintain the 5.0 mg/L DO standard, the results of Scenario 2 show how much Ultimate Oxygen Demand (UOD, the sum of CBODu and ultimate nitrogen biochemical oxygen demand (NBODu) loadings can be increased above current loadings while maintaining the 5.0 mg/L DO standard.

Scenario 3 – Because no nonpoint source load reductions were required under summer or winter critical conditions in Scenario 1 to maintain the 5.0 mg/L DO standard, the results of Scenario 3 are the same as from Scenario 2.

Scenario 4 – Two flow regimes were evaluated under this scenario: a minimum diversion from the Mississippi River that maintains the 5.0 mg/L DO standard (Scenario 4a) and a maximum anticipated diversion of 1,000 cfs (Scenario 4b). At fully anticipated point source and nonpoint source loading, a minimum flow of 2.1 cfs was determined to be the minimum flow necessary to maintain the 5.0 mg/L DO standard in summer. The 5.0 mg/L DO standard would be maintained in winter even at zero flow.

At the maximum anticipated diversion of 1,000 cfs, no load reductions were required for summer critical conditions (7Q10 flow and temperature of 30.27°C) or for winter critical conditions (7Q10 flow and temperature of 20.80°C) to maintain the 5.0 mg/L DO standard. An explicit 10 percent margin of safety was included in the TMDL calculations.

Scenario 5 – Because no load reductions were required for summer and winter critical conditions under Scenario 1, the load reductions in Scenarios 5a and 5b simply illustrate the relative impacts of loading types on hypothetical projections. Headwater loadings to the subsegment were not eliminated under either Scenario 5a or 5b. Under both summer and winter critical conditions, the impact of eliminating point sources to in-stream DO concentrations is minimal when compared to the results from Scenario 1. This observation underscores the small contribution of oxygen-demanding substances from existing point sources in the subsegment. The impact of eliminating nonpoint sources (other than the Mississippi River diversion) on projected in-stream DO concentrations was also minimal. Slight increases in in-stream DO concentrations (<0.3 mg/L) were apparent for that portion of the subsegment upstream of the Thibodaux weir (River Kilometer 54.0).

Table 2. Calculated Load Allocations, Wasteload Allocations, Margins of Safety, and TMDLs under Scenarios 2, 4a, and 4b for Summer and Winter Condition

	Summer (May-Oct)			**Winter (Nov-Apr)**		
	Scenario			**Scenario**		
Load Description	**2**	**4a**	**4b**	**2**	**4a**	**4b**
Current Point Source Loadings at Critical Conditions (kg/d of UOD)	533	533	533	396	396	396

Current Nonpoint Source Loadings at Critical Conditions (kg/d of UOD)	3,053	3,053	3,053	3,053	3,053	3,053
Maximum Nonpoint Source Loadings at Critical Conditions (kg/d of UOD)	200,009	835	108,666	31,550	810	157,786
Point Source WLA (kg/d of UOD)	533	533	533	396	396	396
Nonpoint Source LA (kg/d of UOD)	17,955	853	97,746	28,355	810	141,968
10% MOS (kg/d of UOD)	2,054	0	10,920	3,195	0	15,818
Assimilative Capacity (kg/d of UOD)	20,542	1,368	109,199	31,945	1,206	158,181
Reserve Capacity (kg/d of UOD)	14,902	0	94,693	25,302	0	138,915
TMDL (kg/d of UOD)	20,542	1,368	109,199	31,945	1,206	158,181
TMDL (lbs/d of UOD)	45,287	3,015	240,739	70,426	2,658	348,724
% Reduction in Nonpoint Source Loading Required	0	0	0	0	0	0
% Reduction in Point Source Loading Required	0	0(1)	0	0	0(1)	0

(1) Nonpoint source loading reduction results from headwater flow reduction, thus no reduction of nonpoint source loading is required along the 108 kilometers of the bayou subsegment.
kg/d = kilograms per day
lbs/day = pounds per day
UOD = Ultimate Oxygen Demand = sum of $CBOD_u$ and $NBOD_u$

Much of coastal Louisiana was built by the process of delta formation through flooding and deposition of sediments by the rise and fall of the Mississippi River. Extensive areas of wetlands and coastal marshes are affected by a high rate of subsidence and degradation, primarily due to a lack of historical sediment and nutrients entering the wetlands. Subsidence is a natural process, but the building of man made levee systems has restricted the Mississippi River's course therefore preventing the natural cycle of the river and the natural process of delta formation. A large portion of the state's coastal wetlands have undergone and continue to undergo a severe deprivation of sediments and nutrients that has led quite literally to the breakup of the natural system. In addition, many of Louisiana's wetlands have become isolated from the riverine sources that created them and are becoming starved for nutrients and organic and inorganic sediments. It should be pointed out that restoration of these eroding wetlands involves supplying nutrients to these wetlands through managed Mississippi River diversions. Any effort to improve water quality in Bayou Lafourche should consider the future potential of using the bayou as conduit for delivering fresh water and sediment to Louisiana's disappearing coast.

The proposed TMDL for DO and nutrients for Bayou Lafourche presents a modified flow scenario, Model Scenario 4b. The modified flow of a 1,000 cfs diversion from the Mississippi River into Bayou Lafourche resulted in no required load reductions to maintain 5 mg/L of DO during summer and winter critical conditions as reported in Section 4. The Bayou Lafourche reintroduction proposed under the Louisiana Coastal Area, Louisiana, Ecosystem Restoration Study (LCA Study) could range from 1,000 to 5,000 cfs. EPA believes that flows greater than 1,000 cfs will result in flow increases that will enhance DO and decrease the likelihood of in-stream nutrient impairment in Bayou Lafourche.

TMDL for Fecal Coliforms

A TMDL for dissolved oxygen and nutrients was prepared by FTN Associates, Ltd. for the Unites States Environmental Protection Agency, Region 6. The summary below is adapted from the TMDL document. Additional information is included in italics.

A list of sources of fecal coliforms to Bayou Lafourche was developed and the relative contribution of each source was estimated. The potential sources, their locations, and miscellaneous comments concerning the sources are listed in Table 3.

Table 3. Sources of fecal coliforms to Bayou Lafourche (subsegment 020401)

Source	Location	Comments
Point Sources	Distributed along the entire length of the subsegment	Should not cause any violation of water quality standards (permit limits are based on meeting standards at the end of pipe)
Water pumped from Mississippi River	at Donaldsonville	Median values of fecal coliform counts for the Mississippi River east of Plaquemines (LDEQ station 0319) were 130-100mL for summer and 140/100mL for winter (based on 1991-2002 data)
Failing septic systems	Distributed along the entire length of the subsegment	Considered to be significant by LDEQ and the South Central Planning Development Commission (SCPDC). Accurate estimate of number of failing septic systems could not be obtained for this TMDL.
Runoff from residential and urban areas	Distributed along the entire length of the subsegment	Considered to be significant by LDEQ and SCPDC. Urban runoff is most significant within towns (Donaldsonville, Thibodaux, Raceland, and Larose).
Runoff from cropland and Pasture	Distributed along the entire length of the subsegment	Expected to be negligible for fecal coliform. Pasture is negligible percentage of total drainage area. No known land application of manure or sludge from wastewater treatment plants in this subsegment.
Wildlife and waterfowl	Distributed along the entire length of the subsegment	Expected to be minor. No large forested areas for wildlife. Does not attract large numbers of waterfowl.

The EPA Bacterial Indicator Tool spreadsheet (EPA 2000a) was used to estimate relative contributions of different sources of fecal coliforms for Bayou Lafourche. The spreadsheet is designed to estimate fecal coliform accumulation rates for input to a watershed model such as HSPF. For this TMDL, though, the spreadsheet was used to estimate relative loadings to the stream. For simplicity, it was assumed that all fecal coliforms accumulating on the land surface would enter the stream.

For runoff from built-up (urban and residential) areas, accumulation rates from Horner (1992) were used. Subcategories of urban land uses (commercial, mixed, residential, transportation and utilities) were assigned different accumulation rates. Incorporated areas within US Census defined urban areas are subject to Phase II stormwater regulations (EPA 2000b). Approximately half the subsegment is a part of the US Census defined Houma urban area (US Census 2002). Thibodaux and Lockport are the only incorporated areas in the Houma urban area in the subsegment (US Census 2002); therefore, fecal coliform accumulations from their urban areas were classified as point sources to be consistent with the Phase II storm water regulations. The lengths of areas along the subsegment associated with each community were used to determine the urban land uses for each point source and the nonpoint urban sources in the sub-basins of the subsegments. Subcategories of urban land uses were split among the point and nonpoint urban areas based on the proportion of the length of the areas to the sub-basin length. It was estimated that Thibodaux accounts for approximately 60% of the commercial and mixed urban land uses in its sub-basin, and 10% of the residential and transportation and utilities urban land uses. Lockport was estimated to account for approximately 25% of all urban land uses in its sub-basin.

For contributions from wildlife and waterfowl, fecal coliform accumulation rates were based on the animal density, which was assumed to be five animals per square mile for each animal included in the spreadsheet (ducks, geese, deer, beaver, raccoons, and "other animals"). *This assumption would lead to the conclusion that 50 animals of each species inhabit the 69 mile length of Bayou Lafourche from Donaldsonville to Lockport. This estimation may fall short of the actual animal density. In addition to wild animals, many residences boarder Bayou Lafourche, and yards may be home to a large number of animals including fowl kept as pets.*

Animal wastes may contribute to fecal coliform loads in Bayou Lafourche

For failing onsite disposal systems, fecal coliform contributions were calculated based on the assumptions that 40% of onsite disposal systems are failing, each failing onsite disposal system serves an average of 2.5 people, and each system generates 70 gal/day per person with a fecal coliform concentration of 10,000/100 mL. An accurate count of the number of failing onsite disposal systems in the subsegment is currently not available. The 40% failure rate was used in approved fecal coliform TMDLs for Mississippi (MDEQ 1999a,b). *This number may not accurately reflect the failure rate in the Upper Bayou Lafourche subsegment. Poor soil conditions and aging treatment systems may lead to a higher failure rate in this area. These same factors may increase the expected pathogen load for these systems.* A report by the South Central Planning and Development Commission (SCPDC) includes an inventory of home sewage systems that was developed for LDEQ for parts of the Barataria and Terrebonne basins including Bayou Lafourche (SCPDC 2001). Based on the GIS data collected for this report, SCPDC has determined that there are approximately 618 individual sewer treatment facilities located in subsegment 020401 (personal communication by TMDL author(s), 7/24/03, Scott Leger, SCPDC). The flow rate and fecal coliform count for failing onsite disposal systems were default values in the spreadsheet based on information from Horsley & Witten (1996). *This information was compiled from assessments conducted in Maine, and may not be representative of local conditions.*

The spreadsheet was modified slightly to include fecal coliform contributions from pumped inflows and point sources. For pumped inflows from the Mississippi River, the contribution of fecal coliforms was estimated by multiplying the median fecal coliform values for the Mississippi River during summer and winter (130/100 mL and 140/100 mL, respectively) by a typical pumping rate of 150 cfs (the pumping rate was based on conversations with personnel operating the pumps). For point source discharges of treated wastewater, the contribution of fecal coliforms was estimated by multiplying the monthly average general permit limit for fecal coliforms (200/100 mL in the summer and 1000/100 mL in the winter) by the sum of the discharge permitted flows.

A summary of the estimated relative contributions of point sources and nonpoint sources of fecal coliforms is shown in Table 4. The TMDL document estimated the two largest sources are water pumped from the Mississippi River and runoff from residential and urban areas. Although failing onsite disposal systems are considered to be a significant nonpoint source they were estimated in the TMDL document to represent less of the total load than these two sources.

Table 4. Relative magnitudes of different sources of fecal coliforms for subsegment 020401

	Percent of total loading	
Source	**Summer**	**Winter**
Point sources (treated wastewater)	1.0%	0.9%
Water pumped from Mississippi River	87.2%	88.0%
Failing septic systems	1.5%	1.4%
Runoff from residential and urban areas	6.8%	6.4%
Wildlife and waterfowl	3.5%	3.3%

The TMDL was developed by calculating a percent reduction from existing levels and then estimating maximum allowable “loads” of fecal coliforms. The overall percent reduction needed in fecal coliforms was determined by taking the observed data for each season and multiplying them by a reduction factor until the data were equal to the seasonal water quality standards plus a margin of safety. This procedure was repeated for each LDEQ monitoring station with fecal coliform data within this subsegment.

The percent reduction was applied only to observed data that were greater than the water quality standard (200/100 mL for summer and 1000/100 mL for winter). For summer, the required percent reductions at the five water quality monitoring stations ranged from 0% to 77%, with an average of 45%. No reductions were required for winter. These results are summarized in Table 5.

Table 5. Summary of percent reductions needed to meet standards			
		Percent Reduction Needed	
Station No.	**Station Description**	**Summer**	**Winter**
0023	Bayou Lafourche near Donaldsonville	77%	0%
0293	Bayou Lafourche at Thibodaux	75%	0%
0112	Bayou Lafourche at Raceland	71%	0%
0294	Bayou Lafourche at Lockport	0%	0%
0111	Bayou Lafourche at Larose	0%	0%

Table 6 shows an estimate of the current fecal coliform load to the subsegment, along with loads that would result from applying the reductions specified for the TMDL.

Table 6. TMDL for Bayou Lafourche (subsegment 020401)

Source	**Summer Current Load (10^8 colonies/day)**	**Summer Reduction %**	**Summer Target Load (10^8 colonies/day)**	**Winter Current Load**	**Winter Reduction %**	**Winter Target Load (10^8 colonies/day)**
WLA (Waste Load Allocation – Point Sources)						
Treated Wastewater	5.4	0	5.4	5.4	0	5.4
Thibodaux Stormwater	4.0	47	2.1	4.0	0	4.0
Lockport Stormwater	0.7	47	0.4	0.7	0	0.7
LA (Load Allocation – Nonpoint Sources)						
Wildlife	19.2	0	19.2	19.2	0	19.2
Failing Septic Systems	16.4	47	8.7	16.4	0	16.4
Other Stormwater	32.6	47	17.3	32.6	0	32.6
Mississippi Pumping	477	47	252	514	0	514
Total Load	556	45	306	592	0	592
Future Growth			38.2			74.0
MOS			38.2			74.0
TMDL			382			740

Based on the assessment of pollutant sources, it will be impossible to achieve a 45% reduction in fecal coliform levels without reducing the inputs to Bayou Lafourche from the Mississippi River (Table 5). However fecal coliform levels in the Mississippi River [*consistently meet*] water quality standards. Therefore, the Mississippi River water is not suspected to be the cause of any violations of fecal coliform standards in Bayou Lafourche and no reductions should be required for loading from the Mississippi River. This indicates that the assessment of pollutant sources in the TMDL document is likely underestimating contributions from sources other than the Mississippi River water (e.g., onsite disposal systems, urban runoff, waterfowl and wildlife).

Sources of Impairment

A water body is intimately connected to the watershed it drains. Therefore, the water quality of Bayou Lafourche has a direct relationship with the practices that occur on the land within the watershed. How we use the land can have a profound effect on the health and productivity of Bayou Lafourche. Diverse land use practices contribute various pollutant loads to the bayou. Research has indicated that particular land use practices may have a notable effect on receiving waters. Water quality data aids in identification of potential sources of degradation in the Bayou Lafourche Watershed. The identification of these sources can help us target management measures at those areas that most likely contribute to the impairment of the bayou.

Hydromodification

What is Hydromodification?

*Hydromodifications (*or hydrologic modifications) are activities that disturb natural flow patterns of surface water and groundwater and have been defined as "...activities which alter the geometry and physical characteristics of streams in such a way that flow patterns change."

Examples of hydromodifications to bayous include dredging, removing snags, straightening, and, in some cases, complete channel relocation. Other examples include construction in or along channels, construction and operation of dams and impoundments, channelization, dredging, and land reclamation activities. Some indirect forms of hydromodification, such as erosion along channel banks or shorelines, are caused many activities, including upland land uses that change the natural physical properties of a channel.

Canal Construction

As the Mississippi River journeyed across Southeast Louisiana, it carried with it and left behind the sediments that built the lands of the alluvial plain. Upon these sediments grew the flora that anchored the shifting earth. As the river abandoned each forgotten conduit, the fragile land began to subside. The rich soil continued to support a prosperous ecology and the growing plants added layers of organic material that balanced the sinking deposits. This community of plants known as *floatant* rested conspicuously above the water and highly saturated soils and came to be known as the “trembling prairie”. This soft organic matter gave little resistance to canal builders as they excavated for drainage or transportation.

When Europeans arrived, man first scarred the land in the name of drainage. The continuously saturated ground was inadequate for habitation or cultivation. To promote agricultural production and the economy, in 1770 Spanish Governor Alexandra O’Reilly instructed each family to construct ditches to drain the land away from the bayou. This practice encouraged the cultivation of land beyond the natural levees of Bayou Lafourche. The highly organic soils in the swamps beyond the natural levee were quickly denuded of their productive capacity and failed to produce the yield of the more fertile soil near the bayou. These canals still exist today as Teriot, Halpin, Sam Foret and many other canals that transect the landscape surrounding Bayou Lafourche.

The lands were drained and cleared, crops were planted and harvested, and the commodities were ready for the market. The next challenge was getting them there. Bayou Lafourche, the Mississippi River, and the Gulf of Mexico provided indirect routes to the trading posts in New Orleans, but the journey was laborious at best and often dangerous. Gulf storms could catch travelers by surprise and the floating debris of the Mississippi easily damaged the wooden boats of the time. A more direct route would shorten travel time, and protect the voyager and the commodities he transported. By 1764 a canal connected the Mississippi River with Lac des Allemands, cutting the distance from Bayou Lafourche to New Orleans by up to half. Other canals were dug to allow farmers to the west to move their goods through Bayou Lafourche to the Mississippi and avoid the Gulf. Some canals are still heavily used today. The Harvey Canal provided an important link to Lower Bayou Lafourche and many other canals were later incorporated into the vital Gulf Intracostal Waterway. A network of smaller canals offered access to outlying areas and provided inhabitants a path for routine transportation throughout the region.

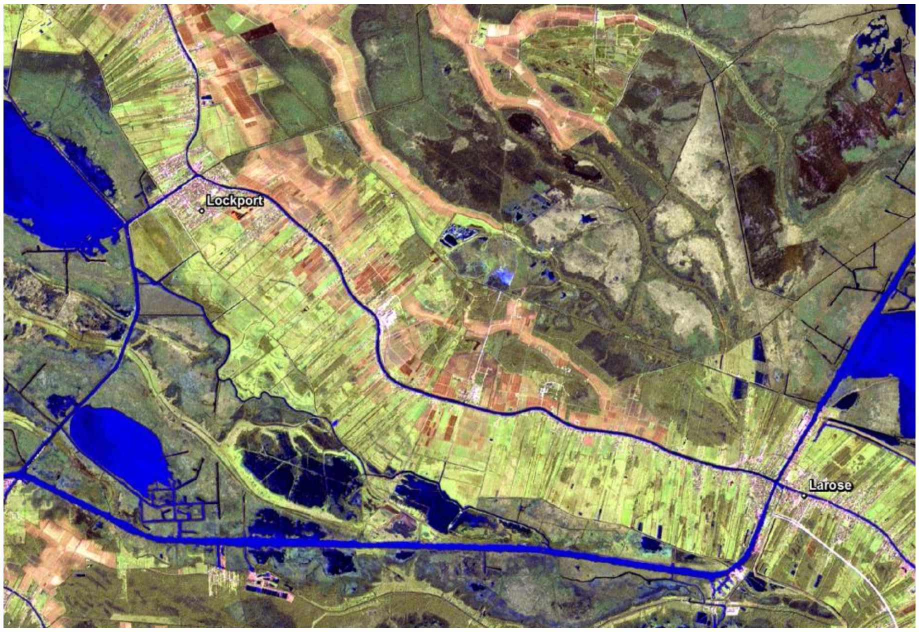
Perhaps the most significant early alterations were at the hands of trappers. Muskrat (and later nutria) pelts proved to be an important source of winter income for the residents of coastal Louisiana. To reach the productive trapping grounds, residents dug small canals called traĩnasses. These shallow canals were dug by hand and were only wide enough to carry the pirogues used by trappers. As pelt prices rose, and trapping became increasing profitable, more traĩnasses were constructed by a growing number of trappers. The marshes of the Barataria Basin were soon etched with the woven lines of hundreds of small canals. These canals not only provided access to trappers, but also to damaging salt water,

and eroding currents; a characteristic of all the manmade channels of coastal Louisiana.

Another commodity equally important to the people of the Bayou Lafourche region was cypress. From the moment the first ax fell to clear the land for farming, a market existed for the valuable lumber that was produced as a byproduct of agricultural expansion. As farm expansion neared its limits beyond the natural levees of Bayou Lafourche, another method of lumber harvest was required. The soft, inundated floor of the cypress-tupelo swamp made normal access impossible. To overcome this, canals were excavated and machinery was floated in to assist in harvest and transport. Logs were dragged into the access channels and floated to mills. The dragged logs left characteristic fan-shaped scars that radiated from these channels. Channels were continuously excavated and extended to provide new access to virgin stands of timber.

Oil rigs on Bayou Lafourche circa 1940

The most drastic and visible alteration to the coastal landscape, and particularly to the Barataria Basin began in the early 20th century when the first canals were excavated to access the rich petroleum reserves hidden beneath Louisiana's marshes. Again, the saturated sediments required an alternative to the common practices of the industry. Once more, man-made canals were the perceived solution. Thousands of miles of access channels were burrowed into the marsh. From these channels, thousands more ancillary canals stretched toward each well used to extract valuable crude from deep



Manmade channels are visible in satellite imagery. Prominent are Company Canal that crosses Bayou Lafourche at Lockport and the Intracoastal Waterway at Larose.

below the marsh. When the oil was extracted, yet more canals were dug to lay the pipeline used to transport the goods for storage and refining. Millions of cubic yards of sediment were removed and deposited adjacent to each canal. These spoil banks and canals permanently altered the hydrology of the region by blocking the natural flow of water and providing a conduit for salt water intrusion.

Though each channel may vary in size and purpose, they all share common characteristics. When a channel is excavated through Louisiana's fragile wetlands, the adjacent landscape becomes exposed to the erosive potential of the water that fills it. Flowing water driven by runoff, wind, or tides, can quickly erode canal banks. A channel as small as the trapper's traĩnasse, can grow over time to be as wide as a petroleum access canal.

Manmade channels also provide a conduit that allows saltwater to infiltrate inland brackish and fresh marshes. The diverse floras of the Barataria Basin are specialized for survival in each unique environment. Salt water carried though manmade channels by wind or tides, quickly decimates fresh marsh grasses that cannot tolerate higher salinity. As these plants die, their roots no longer provide stability to the underlying sediment and once gone, the marsh grasses can no longer produce the organic material that balanced the subsiding earth. The loss of root structure and productivity accelerates bank erosion and can turn a once productive wetland into open water.

Channels may also transport pollution-laden runoff that would have once been naturally filtered as it flowed through the wetland. Nutrients are transported to lakes or carried to the Gulf where they promote eutrophication that consumes oxygen vital to aquatic life.

The Damming of Bayou Lafourche

The single largest impact to Bayou Lafourche came at the turn of the twentieth century. By that time rail lines connected the bayou residents to trading posts in New Orleans and beyond. The bayou was no longer critical to transportation and growing frustration with spring flooding had come to a head. In February of 1904 a damn was completed on the banks of the Mississippi River at Donaldsonville, severing Bayou Lafourche from its lifeline and forever changed the physical, chemical, biological, and social characteristics of the region.

Walter Lemann Sr. Pumping Station in Donaldsonville

The residents of Bayou Lafourche had initially requested the installation of a set of locks at Donaldsonville, but the locks were never constructed. Navigation and flow from the Mississippi River was completely obstructed. The swamps and marshes of the Bayou Lafourche region were cut off from the flow of fresh water that sustained them. The bayou was effectively transformed into a long, still lake. Without the constant flow of water from the Mississippi River, the bayou began to fill with sediment from runoff and construction on the bayou's banks. The bayou became a stagnant pool of water. When Works Project Administration (WPA) writers passed through the region in the 1930's and 40's, they described bayou Lafourche as a "stagnant waterway," with its "upper reaches" "covered with water hyacinths" (Emmer and others 2003).

The lack of fresh water from the Mississippi River was exacting its toll on the residents as well. Without a consistent source of water, utilities had trouble supplying their customers with drinking water. The flow in Bayou Lafourche was no longer adequate enough to prevent salt water from encroaching up the bayou from the gulf. This further limited the supply of potable water. In 1955 the Bayou Lafourche Freshwater District constructed a pump and siphon at Donaldsonville to improve drinking water conditions on the bayou. At 340 cubic feet per second, the pump introduced only a fraction of what once flowed down Bayou Lafourche from the Mississippi River. This slow flow resulted in the deposition of most of the Mississippi River's sediment in the first several miles of the Bayou Lafourche. Sedimentation resulted in the constriction of the bayou which today is only capable of conveying 200 cubic feet per second from the pump station on the Mississippi River (Emmer and others 2003).

While sampling data is not available for the period prior to the construction of the dam or pump station, it is likely that water quality was adversely impacted by these events. Continuous flow from the Mississippi River once constantly flushed pollutants from Bayou Lafourche. Reduced flow now allows sediment, nutrients, pesticides, and septic waste to accumulate in the bayou. These pollutants lead to eutrophic conditions that reduce dissolved oxygen and threaten aquatic life. This same impaired bayou is a source of drinking water to the residents of the Bayou Lafourche region.

Bayou Lafourche Weir at Thibodaux

Despite the construction of the pump and siphon at Donaldsonville, the fluctuating water level and the threat of salt water intrusion from the Gulf of Mexico, made Bayou Lafourche an undependable source of drinking water for much of the region. To resolve this, a weir was built in Bayou Lafourche at Thibodaux. The weir maintains the minimal water level necessary to allow the Bayou Lafourche Fresh Water District to provide drinking water to over 2000 customers. The weir also prevents salt water from moving up the bayou

Weir in Bayou Lafourche at Thibodaux

beyond Thibodaux, although it does little to protect fresh water intakes south of the city.

Above Thibodaux, activities within the watershed can have significant impacts on water quality within the impoundment behind the weir. Watershed activities, such as agriculture, forestry, or urbanization can lead to changes in water quantity and quality. Agricultural and forestry practices that lead to sediment-laden runoff may result in increased sediment accumulation within an impoundment. Chemicals (e.g., pesticides and nutrients) that are applied on agricultural crops can be carried with sediment in runoff. Increases in urbanization that result in more impervious areas within a watershed often result in dramatic changes in the quantity and timing of runoff flows. These external sources are compounded by the weir and may result in short-and long-term water quality changes within the impoundment area. As water approaches the weir, flow velocity slows. Sediment and pollutants suspended in the water column may settle and accumulate behind the weir. (EPA 2006)

Riparian Destruction

Shoreline lacking riparian protection

In addition to historic impacts, the banks of Bayou Lafourche continue to be degraded by landowners who unwittingly remove vegetation from the shore. The roots of the natural riparian vegetation that flourishes along the bayou's edge help to protect the shoreline from erosion by providing a structure that secures the soil on these highly erodible slopes. When these plants are removed, soil is easily washed away by rain or by the flow of the bayou. As banks erode, homes, business, and roads are at risk of structural damage as their foundations are undermined. The eroded sediment is deposited in the channel of the bayou and limits its ability to store and convey water. This increases the risk of flooding and threatens to inhibit drinking and irrigation water intakes.

Agriculture

The first European settlers of Bayou Lafourche practiced subsistence farming; cultivating and harvesting only the resources necessary to fulfill the needs of their families. A family farm operation might include cotton, sugar, peas, beans, sweet potatoes, rice, and corn in addition to other vegetables and fruits. This food source was often supplemented by the harvest of wild game which was abundant in the area.

Early commercial crop production began with indigo, cotton, and to a lesser extent corn and rice. Returns on these staple crops were mediocre in the Bayou Lafourche region. The first attempts to cultivate sugarcane were met with frustration. The frosts of South Louisiana proved unbearable to the delicate cane. The introduction of the more hard variety of ribbon cane and Etienne Bore's successful attempt in 1794 to granulate cane syrup sent investors searching for land on which to cultivate their new commodity. Many of these investors found suitable land on the rich natural levees of Bayou Lafourche. Family farmers who had made their homes along the bayou were often quick to sell their land for a perceived profit. The plantation era of Bayou Lafourche was born.

Commercial production of sugar cane was a labor intensive process that required a capital investment in laborers and equipment. Loans were procured to acquire these assets. To repay creditors, landowners cleared more land to cultivate more cane. Land clearing necessitated additional laborers whose purchase required additional funding. This self-perpetuating growth led to expansion of sugar plantations down Bayou Lafourche and away from the bayou to the swamps beyond the natural levees. Each plantation was self-sufficient and produced (in addition to cane) all the produce necessary to sustain its workforce and its livestock. This required additional land for cultivation. Forests were cleared and canals were constructed to drain lowland areas. The waters of Bayou Lafourche were used to irrigate crops and provide for any other use necessary during day to day life on the plantation.

Production levels of sugar cane have varied significantly since it was first introduced to the shores of Bayou Lafourche. Despite eras of boom and despair, sugar cane continues to rein as the predominant agricultural commodity of the Lafourche region. Advancements in crop production have proved advantageous to farmers, and occasionally harmful to the natural ecology of the surrounding area. A suite of chemicals has been developed to deal with natural threats and promote increased production. As rain water washes over fields, canals constructed to expedite drainage carry these herbicides, insecticides, and fertilizers into receiving canals, bayous, and lakes.

When fertilizer reaches Bayou Lafourche it works quickly to fulfill the purpose it was intended to perform in the field. Elevated levels of nitrogen and phosphorus promote plant growth in the bayou. Rather than maximizing crop yields, these fertilizers increase algae production and promote the growth of aquatic plants that often choke the bayou during spring and summer months. This unsightly growth limits recreational use and can clog intakes used to extract irrigation and drinking water from the bayou. As the days shorten and the weather cools, these dense mats of aquatic plants die. Decaying plant matter is exploited by organisms that utilize the vegetation as a food source. As these organisms consume the decaying plants, they also consume oxygen. A population explosion of these microscopic organisms can quickly consume nearly all available oxygen, greatly impacting fisheries and potentially resulting in fish kills.

Insecticides used to target agricultural pests can also decimate aquatic insects vital to the productivity of the Bayou Lafourche ecosystem. Insects often provide the primary source of nourishment to larval fish. Some of these fish will mature to become part of a lucrative sport fishing industry. Others will be consumed by other small fish, which will, in-turn, be consumed by larger sport fish. The introduction of pesticides threatens to collapse this food chain by eliminating the base on which it is built. The impact is not limited to aquatic organisms. This community of insects and fish supports countless larger terrestrial communities of amphibians, birds, reptiles, and mammals.

When agricultural herbicides enter water bodies, they often execute their largest impact on native vegetation. Native aquatic plants are a food source to many species and act as shelter to others. When native plant species are weakened by herbicides, they are often replaced by exotic or introduced species. Exotic species are not as well suited to fulfill the roll as food and shelter to aquatic animals. The result is a decline in productivity at every level similar to the impact of insecticides as discussed above.

Perhaps the greatest potential impact from agriculture is sedimentation. As raindrops impact bare soil, they dislodge sediment particles that are carried by runoff over fields, into drainage channels, and eventually into receiving waters. Sediments can fill channels and limit their ability to convey water. This ability is especially important in Bayou Lafourche. The water conveyed by the bayou is used to irrigate fields and to provide drinking water to thousands of homes. Sediment clouds water and limits the production of food sources for aquatic animals. Sediment can also carry pesticides, herbicides, fertilizers, and other potentially harmful chemicals. Sedimentation potential is increased by eroding channel walls and improper agricultural practices.

Urban Runoff

Urban NPS pollution has severely impacted many of the water bodies receiving runoff from major cities in Louisiana, but urban NPS pollution is not limited only to large communities. Rural areas such as those near Bayou Lafourche contribute to urban NPS pollution as well. The Bayou Lafourche Watershed is also home to Louisiana Highways 1 and 308. These roads are heavily utilized for commercial transport, agricultural activities, and by residents. Petroleum products and particulates from exhaust become concentrated on roadways and are easily washed into Bayou Lafourche during rain events.

Past concerns with urban runoff have primarily dealt with the prevention of localized flooding. Only recently has urban runoff been considered as a significant contributor to the degradation of the quality of receiving waters. Water quality problems are not always immediately obvious and are less dramatic than floods. The major problem created by urban stormwater runoff is degradation of the quality of receiving waters. In some cases, the load applied to neighboring water bodies by stormwater runoff is greater than point source loads.

Urban nonpoint source pollution is the result of precipitation washing over the surfaces of developed areas. As precipitation falls on developed areas, it picks up contaminants from the air, littered and dirtied streets and sidewalks, petroleum residues from automobiles, exhaust products, heavy metals and tar residuals from roads, chemicals applied for fertilization and weed and insect control, and sediments from construction sites. The dumping of chemicals such as used motor oil and antifreeze into storm sewers is another source of urban NPS pollution. Illegal hookups of storm drains to sanitary sewers can result in increased volumes of flow to waste water treatment plants causing more frequent overflows of sewage into receiving waters. Constituents of urban NPS pollution are extremely variable and can include sediment, nutrients, toxic substances, oxygen demanding substances, petroleum products, and pathogenic micro organisms.

Urbanization has a profound impact not only on water quality, but on the hydrologic characteristics of watersheds as well. In undeveloped natural drainage areas, the volume and rate of stormwater runoff from a particular rainfall event is primarily determined by the natural detention and infiltration characteristics of the land, and is related to topography, soil types, and vegetative cover. In urbanizing an area, the dominating factor of impervious surfaces is added. With less detention and infiltration due to impervious surfaces, runoff volume increases, as well as the rate of stormwater runoff. Flooding and stream channel degradation in urbanizing watersheds have obvious adverse impacts upon public convenience, safety, and aesthetics, but there are some significant adverse impacts on water quality as well. When streams overflow their banks, there is an increased opportunity for pollutants including trash and debris to enter the flow of water. Erosion of the stream channel represents a significant source of sediment pollution, and the loss of vegetation along stream banks reduces the pollutant assimilation capacity of a stream.

Onsite Disposal Systems (Septic Tanks)

As Bayou Lafourche was settled, homes were constructed on the high ground of the natural levees adjacent to the bayou. This high ground afforded protection from flooding and the rich alluvial soils were ideal for farming. Unfortunately, the proximity of homes to the water makes Bayou Lafourche particularly susceptible to pollution from improperly installed or poorly maintained onsite disposal systems. A high water table compounds this threat. For over a decade, sampling has shown that Bayou Lafourche is unable to support its designated use of primary contact recreation. Louisiana Environmental Regulatory Code defines primary contact recreation as: any recreational or other water contact use involving prolonged or regular full-body contact with the water and in which the probability of ingesting appreciable amounts of water is considerable (LAC 33:IX.1105). This means that fecal coliform bacteria in the bayou exceed a level that puts humans at risk of illness if water is ingested during swimming or participation in water sports. It is difficult to isolate a specific source of these fecal coliform bacteria, but it is likely that failing onsite disposal systems are a discernable contributor.

Septic tank outfall

Volume 6 of the State of Louisiana's Water Quality Management Plan: Louisiana's Nonpoint Source Management Plan, describes the potential impact of onsite disposal systems on Louisiana's surface and ground waters.

A notable portion of Louisiana's nonpoint source pollution may be attributed to sewerage discharges from homes, camps, and businesses that are not connected to municipal sewerage treatment facilities. It is estimated that 1,323,600 people in Louisiana treat and dispose of their sewage with individual waste disposal systems, and that over 50% of these systems are malfunctioning due to incompatible soil types or lack of maintenance. These failing systems are a major cause of water quality degradation in Louisiana’s bayous and fresh water aquifers.

Ground and surface water pollution are major considerations when on-site systems are used. Sewage treatment and disposal systems should be designed and operated in a manor, which prevents the degradation of ground and surface water quality. Onsite disposal systems used in undersized lots or where soils are unsuitable for proper treatment of wastewater are subject to undesirable conditions such as widespread saturation of the soil and malfunction of the treatment system. Malfunctioning systems result in sewage leaching into ground and surface water.

Convetnional septicl systems (those with a drain field of filter bed) must be designed so that they are compatible with the geological attributes of the area. If the ground water level is high (less than 4 feet below the surface) or if the soil is extremely permeable, the soil will not be effective in removing pollutants and the ground water may become contaminated, resulting in a public health hazard. Many diseases, including infectious hepatitis, typhoid fever, dysentery, and some forms of diarrhea are caused by water and food contaminated with sewage and can easily be spread by flies.

Stagnant water near a septic tank outfall

Eighty-seven percent of the soil associations in Louisiana are considered inadequate for conventional onsite disposal systems as determined from the Soil Limitation Ratings for Sanitary Facilities. Another major component to the pollution caused by onsite disposal systems is inadequate enforcement of the State Sanitary Code. The code covers general requirements, responsibilities, and controls for sewage facilities. The code specifically states that no disposal system should be installed without first obtaining a written permit from the State Health Officer. The DHH regulations describe in detail the acceptable capacities, materials, and construction of septic tanks, field lines, sand filters, and oxidation ponds. Also given are minimum distances from dwellings, wells, and property lines for the various system components. Provisions are given for the type of secondary treatment to be used based on the results of the percolation test, the level of the ground water, and the level of impervious strata below the surface. The DHH also states that mechanical treatment plants are to be used only when septic tanks could not function properly, and gives reference to the required standards for mechanical treatment plants.

Grazing

Early settlers used the natural levees of Bayou Lafourche to graze livestock for food and assistance in cultivation. As early as 1744, land near Bayou Lafourche was being utilized specifically for grazing cattle (Pearson 1996). The natural levees of Bayou Lafourche and its distributaries provided adequate habitat for the production of beef cattle for trade in New Orleans. Today, pasture land constitutes the largest active land use in the Barataria Basin (Barataria 2006). The grazing of livestock presents a set of unique challenges to protecting water quality for wildlife and human benefit.

Livestock can produce a large amount of fecal waste. These wastes may contain a considerable amount of nutrients that are not fully utilized by the animal. Rainfall can carry this waste to nearby waterways where nutrients can lead to eutrophic conditions that promote algae growth and reduce oxygen levels. Livestock waste may also contain pathogens that threaten human health if consumed. These pathogens are carried to waterways by runoff and may be inadvertently ingested by swimmers, waders, or anglers. These problems are compounded when livestock are allowed direct access to canals and bayous. When waste is deposited in or adjacent to waterways, it is more likely to adversely impact water quality.

Sediment is the largest pollutant by volume of surface water in the nation. When cattle are concentrated in a single location, such as around feeding and watering areas, they often remove vegetative cover and expose the soils beneath. Exposed soil can easily be dislodge by falling rain and then carried to water bodies by runoff. Sediment increases the turbidity of water, thereby reducing light penetration, impairing photosynthesis, altering oxygen relationships and may reduce the available food supply for certain aquatic organisms. It can affect fish populations adversely in areas where sediment deposits cover spawning beds. Increased sediment also fills bayous, lakes, and shipping channels (LSU AgCenter 2002).

Some landowners unwittingly allow cattle access to riparian areas and stream banks. Streambank stability is directly related to the species composition of the riparian vegetation and the distribution and density of these species. During high water, riparian vegetation protects the banks from erosion, reducing water velocity along the stream edge, and causing sediments to settle out. Trees provide shade and streambank stability because of their large and massive root systems. Trees that fall into or across streams create high quality pools and contribute to channel stability. Brush protects the streambank from water erosion, and its low overhanging height adds cover that is used by fish. Grasses form the vegetative mats and sod banks that reduce surface erosion and erosion of streambanks. (EPA 2003)

When animals repeatedly graze directly on erodible streambanks, bank structure may be weakened causing soil to move directly into the stream. Excessive grazing on riparian vegetation can result in changes in plant community composition and density and can negatively impact bank stability and the filtering capacity of the vegetation. (EPA 2003)

Nonpoint Source Management Measures

ICWW locks in Larose

Growing public awareness and concern for controlling water pollution led to enactment of the Federal Water Pollution Control Act Amendments of 1972. As amended in 1977, this law became commonly known as the Clean Water Act. The Act established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry. The Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. (epa.gov)

The Clean Water Act was largely successful in addressing point source discharges throughout the United States. As permits were issued and enforced, it became apparent that a new approach was needed to tackle the remaining sources of pollution in the nation's waters. Today, nonpoint source pollution is the leading cause of water quality impairment. The characteristics of nonpoint source pollution make it considerably more difficult to control than its point source counterpart. Diffuse sources that are difficult or impossible to locate make a national permitting system for nonpoint source pollution burdensome to implement.

Currently, nonpoint source pollution is addressed on a voluntary basis through the cooperation of national, state, and local partners. Funding has been used to develop and evaluate management measures and best management practices that are effective in controlling nonpoint source pollutants. Because nearly all human activity has the potential to contribute to nonpoint source pollution, it is imperative that pollution sources be addressed on an individual basis. Minute solitary sources throughout a watershed can coalesce to have a significant impact on receiving waters. It is the responsibility of each stakeholder to ensure that their actions have a minimal impact on their watershed. It is hoped that a sense of pride and place will promote the adoption of practices that improve and protect water quality.

Implementation of management measures and best management practices (BMPs) are the building blocks for watershed protection and the improvement of water quality. Because watersheds encompass a broad range of land uses, the description of BMPs for the Bayou Lafourche Watershed is divided into categories such as hydromodification, agriculture, and urban runoff. Each category contains site-specific BMPs that minimize a particular source of nonpoint source pollution. Best management practices can include structural controls and/or nonstructural controls. Structural BMPs or controls are those (whether natural or man-made) that filter, detain, or reroute contaminants carried in surface runoff. Nonstructural BMPs utilize techniques such as land-use planning, land-use regulations, and land stewardship to eliminate or minimize sources that may generate nonpoint source pollutants. Descriptions of the BMPs suggested for the land uses identified in the Bayou Lafourche Watershed have been included in this plan. This is not meant to be an exhaustive list of all possible solutions. A more complete list of BMPs can be viewed in the LDEQ Nonpoint Source Pollution Management Plan, on the Nonpoint Source Pollution Program website (http://nps.ldeq.org) or by contacting the Natural Resource Conservation Service (NRCS).

Hydromodification Management Measures

Headwaters of Bayou Lafourche at pump station in Donaldsonville

The management measures below assume that the structures that currently exist are a necessary part of the infrastructure. This may not be the case for many of the channels or structures in the Bayou Lafourche region that were crated long ago for purposes that no longer exist. The goal of any practice intended to mitigate the impact of hydromodification should be to return the hydrology of an area to its most functional form. In many cases, it is not practical or possible to return an area to the same condition in which it existed before disturbance began. Even in those areas, it is likely that improvements can be made that improve water quality and create a more sustainable habitat for humans and wildlife.

The following management measures have been adapted from the 2006 EPA document, "National Management Measures to Control Nonpoint Source Pollution from Hydromodification" In that document, EPA provides an in-depth review of the strategies that can be utilize to mitigate the impacts of past, present, and future hydromodification. The document can be viewed online via EPA's website at www.epa.gov.

The management measures below are not specific practices. The complexity of the region would make an exhaustive list of suggested practices impractical. Rather, the measures below help to build a framework from which a comprehensive plan can be developed that includes complete consideration of all potential impacts caused by hydromodification projects and future maintenance of those projects.

Channelization and Channel Modification

Channelization can cause changes, such as a reduction in freshwater supply, and results in the faster delivery of pollutants. Channel modification may result in a combination of harmful effects (higher flows or increased risk of flooding) and beneficial effects. The two management measures for channelization and channel modification are intended to protect water bodies by ensuring proper planning before the proposed project is implemented, which helps to correct or prevent detrimental changes to the in-stream and riparian habitat. Implementation of the management measures can also ensure that operation and maintenance programs for existing projects improve physical and chemical characteristics of surface waters when possible.

Management Measure for Physical and Chemical Characteristics of Surface Water: Ensure that the planning process for new hydromodification projects addresses changes to physical and chemical characteristics of surface waters that may occur as a result of the proposed work. For existing projects, ensure that operation and maintenance programs use any opportunities available to improve the physical and chemical characteristics of surface waters.

Bulkhead on Bayou Lafourche

Management Measure for In-stream and Riparian Habitat Restoration: Correct or prevent detrimental changes to in-stream and riparian habitat from the impacts of channelization and channel modification projects, both proposed and existing. As an example, this may include a thorough evaluation of snagging or spraying practices which may result in a discontinuance of those practices if they are found to produce little benefit in flood control. Limiting or discontinuing such a practice would improve riparian habitat, limit maintenance dredging, reduce costs, and improve water quality.

Dams & Weirs

When dams or weirs are constructed, the turbidity and sedimentation in a waterway is often increased. Construction activities, chemical spills during operation or maintenance, and reduced downstream flushing alter the nature of the water body. The management measures for dams and weirs are intended to be applied to the construction of new dams or weirs, as well as any construction activities associated with maintenance. They can be applied to dam operations that result in the loss of desirable surface water quality and in-stream and riparian habitat.

Management Measure for Erosion and Sediment Control: Prevent sediment from entering surface waters during the construction or maintenance of dams.

Management Measure for Chemical and Pollutant Control: Prevent downstream contamination from pollutants associated with dam construction and operation and maintenance activities.

Management Measure for Protection of Surface Water Quality and In-stream and Riparian Habitat: Protect the quality of surface waters and aquatic habitat in reservoirs and in the downstream portions of rivers and streams that are influenced by the quality of water contained in the releases (tailwaters) from reservoir impoundments.

A proposed plan to increase the flow in Bayou Lafourche includes the removal of the weir at Thibodaux. This would return the hydrology of the bayou to a more natural state. The proposal also includes the construction of additional controls in other parts of the bayou. The construction of these controls should be evaluated and conducted in such a way as to minimize the potential temporary and long-term impacts that may be incurred as a result of their construction.

Segment of Bayou Lafourche that retains riparian protection

Streambank and Shoreline Erosion

Nonpoint source pollution results from the erosion of streambanks and shorelines. As upstream runoff increases, more erosion occurs on downstream streambanks. The streambank and shoreline erosion management measure promotes the necessary actions required to correct streambank and shoreline are natural processes, this management measure is not intended to be applied to all erosion occurring on streambanks and shorelines.

Management Measure for Eroding Streambanks and Shorelines: Protect streambanks and shorelines from erosion and promote institutional measures that establish minimum setback requirements or measures that allow a buffer zone to reduce concentrated flows and promote infiltration of surface water runoff in areas adjacent to the shoreline. When possible, measures to control erosion should be nonstructural and should restore streambanks to their natural state. This may include replanting of riparian areas with natural vegetation to promote root structures that maintain streambanks and protect them from erosion.

Agriculture Management Measures

Farmers, scientist, and other groups have worked over the years to develop a set of best management practices (BMPs) to help protect Louisiana's valuable waters. BMPs are practices used by agricultural producers to control the generation and delivery of pollutants from agricultural activities to water resources and thereby reduce the amount of agricultural pollutants entering surface and ground waters (LSU AgCenter 2000). The Louisiana State University AgCenter has published a set of BMPs specifically targeted at reducing the impact of sugarcane production. The document, "Sugarcane Production Best Management Practices" can be obtained by contacting the LSU AgCenter or through their website at www.lsuagcenter.com. A selection of BMPs is highlighted below. For a complete list of BMPs, contact your local United States Department of Agriculture (USDA) Service Center, LSU AgCenter parish office, or Louisiana Department of Agriculture and Forestry (LDAF) Conservation District.

Vegetative Buffering (Filter) Strips (NRCS Code 350)

Filter strips are designated as vegetated areas to treat runoff and are not part of the adjacent cropland rotation. Overland flow entering the filter strip is primarily sheet flow. The filter strip is established as permanent herbaceous vegetation consisting of a single species or mixture of grasses, legumes, and/or forbs adapted to the site and practices used in the management system. Annuals may be used in conjunction with surface irrigation tailwater. (NRCS 2005)

Vegetative filter strips utilize the natural ability of vegetation to filter nutrients from runoff. Filter strips also slow the movement of water, allowing sediment to settle out of suspension thus limiting the amount of sediments that reach receiving waters. Filter strips enhance riparian areas by providing additional habitat to native species.

Grassed Waterways (NRCS Code 412)

Grassed waterways are natural or constructed channels that are shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff. They are designed to convey runoff without causing erosion or flooding and to improve water quality. (LSU AgCenter 2000)

Grassed waterways, like filter strips, utilized the ability of vegetation to absorb nutrients and remove sediment from suspension. Vegetation roots provide structure to waterways, limiting channel erosion. These qualities combine to limit maintenance and costs while improving water quality.

Riparian Zones (NRCS Code 391A)

A riparian zone consists of the land adjacent to and including a stream, river, or other area that is at least periodically influence by flooding in a natural state. Similar to vegetated filter strips, plants in riparian areas effectively prevent sediment, chemicals, and organic matter from entering bodies of water. Unlike filter strips, riparian zones use larger plants such as tress or shrubs, as well as grasses or legumes. Vegetated filter strips are often used in riparian areas as initial filtering components next to crop field borders. (LSU AgCenter 2000)

In additional to filtering runoff, riparian areas protect channel walls by providing structure to soils. Riparian areas also act as habitat for native animals important to culture and recreation. By protecting the establish floodplain, flow velocity is reduced, and downstream flooding is minimized.

Nutrient Management (NRCS Code 590)

A sound soil fertility program is the foundation upon which a profitable farming business must be built. Agricultural fertilizers are a necessity for producing abundant, high quality food feed, and fiber crops. Using fertilizer nutrients in the proper amounts and applying them correctly are economically and environmentally important to the long-term profitability and sustainability of crop production (LSU AgCenter 2000). Nitrogen and phosphorus are the two largest sources of nutrient enrichment in Louisiana’s waters. Proper application of fertilizers limits the likelihood that they will end up in nearby waterways and increases profitability by reducing waste.

The LSU AgCenter specifically recommends 10 practices in their publication, “Sugarcane Production Best Management Practices”:

1. Soil test for nutrient status and pH to:
    - determine the amounts of additional nutrients needed to reach designated yield goals and the amount of lime needed to correct soil acidity problems
    - learn the Cation Exchange Capacity (CEC) and the organic matter concentration so as to determine how much of these nutrients the particular soil is capable of holding
    - optimize farm income by avoiding excessive fertilization and reducing nutrient losses by leaching and runoff
    - identify other yield-limiting factors such as high levels of salts or sodium that may affect soil structure, infiltration rates, surface runoff and, ultimately, groundwater quality

2. Base fertilizer applications on:
    - soil test results
    - realistic yield goals and moisture prospects
    - crop nutrient requirements
    - past fertilization practices
    - previous cropping history

3. Manage low soil pH by liming according to the soil test to:
    - reduce soil acidity
    - improve fertilizer use efficiency
    - improve decomposition of crop residues
    - enhance the effectiveness of certain soil applied herbicides

4. Time nitrogen applications to:
    - correspond closely with crop uptake patterns
    - increase nutrient use efficiency
    - minimize leaching and runoff losses

5. Inject fertilizers or incorporate surface applications when possible to:
    - increase accessibility of fertilizer nutrients to plant roots
    - reduce volatilization losses of ammonia N sources

- reduce nutrient losses from erosion and runoff

6. Use animal manures and organic materials:
   - when available and economically feasible
   - to improve soil tilth, water-holding capacity, CEC and soil structures
   - to recycle nutrients and reduce the need for commercial inorganic fertilizers

7. Rotate crops when feasible to:
   - improve total nutrient recovery with different crop rooting patterns
   - reduce erosion and runoff reduce diseases, insects and weeds

8. Use legumes where adapted to:
   - replace part or all of crop needs for commercial N fertilizer
   - reduce erosion and nutrient losses
   - maintain residue cover on the soil surface

9. Control nutrient losses in erosion and runoff by:
   - using appropriate structural controls
   - adopting conservation tillage practices where appropriate
   - properly managing crop residues
   - land leveling
   - implementing other soil and water conservation practices where possible
   - using filter strips

10. Skillfully handle and apply fertilizer by:
    - properly calibrating and maintaining application equipment
    - properly cleaning equipment and disposing of excess fertilizers, containers and wash water
    - storing fertilizers in a safe place

Proper nutrient management results in the application of fertilizers at the proportion and quantity that crops can fully utilize. By limiting the use of excess fertilizers, nutrient management protects the environment and improves farm profitability.

Comprehensive Nutrient Management Plans

Both the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Agriculture (USDA) are encouraging a voluntary approach to handling nonpoint source issues related to agriculture. The implementation of Comprehensive Nutrient Management Plans (CNMPs) by all agricultural producers will ensure that fertilizers are managed in an environmentally friendly fashion.

A CNMP is a strategy for making wise use of plant nutrients to enhance farm profits while protecting water resources. It is a plan that looks at every part of your farming operation and helps you make the best use of manures, fertilizers and other nutrient sources. Successful nutrient management requires thorough planning and recognizes that every farm is different. The type of farming you do and the specifics of your operation will affect your NMP. The best CNMP is one that is matched to the farming operation and the needs of the person implementing the plan.

The LSU AgCenter, the USDA Natural Resources Conservation Service, the Louisiana Department of Agriculture and Forestry, certified crop advisors or other private consultants will be able to assist you in developing parts of a comprehensive nutrient management plan. A CNMP is a good tool to help you use your on- and off farm resources more efficiently and prevent future problems. A successful NMP will help you obtain the maximum profit while protecting the environment (LSU AgCenter 2000).

Urban Runoff Management Measures

Addressing nonpoint source pollution in diverse developed areas is a difficult task. The amalgamation of potential pollutants is paralleled by no other land use. The level of alteration caused by development requires that management measure and best management practices be implemented on a household scale. Urban management measures generally fall into two categories. The goal of the first category is to limit activities that result in the deposition of potential pollutants which may eventually be washed into receiving waters. The second category consists of the implementation of controls that limit the amount of and the rate at which rainfall reaches receiving waters, thus allowing pollutants time to be assimilated by the natural environment.

Aerial image of Thibodaux, LA along Bayou Lafourche

Preventing NPS pollutant loading in urban areas of the watershed involves managing existing sources of pollution and preventing new ones. A considerable portion of the Bayou Lafourche watershed consists of roads and residential lots. Nonpoint Source pollution is driven by stormwater runoff, therefore BMPs should be focused on management strategies that prevent or reduce sources of NPS pollution. Increasing the public's level of environmental awareness is the first step for solving these types of problems in developed areas. Another consideration is current and future development in the watershed that may result in nonpoint source pollution. Decisions regarding land-use planning and protection of urban water resources are usually governed at the municipal level. For controlling sources of NPS pollution, BMPs are best implemented through site plan controls, stormwater management plans, subdivision agreements, local ordinances, and erosion and control guidelines and standards. When attempting to implement such BMP programs, success will depend upon whether the local public has a clear understanding of the program and its overall goals and objectives. Examples of these objectives include measures such as:

- Minimize impervious areas to decrease runoff quantity and improve quality from source areas
- Conserve the critical and sensitive areas of the watershed
- Protect local streams and rivers from adverse effects of urbanization
- Preserve open-space land for aesthetics and recreation while also preserving water quality
- Provide fair sharing of costs and benefits of protecting water quality

A selection of management measures have been adapted below from the EPA document, "National Management Measures to Control Nonpoint Source Pollution for Urban Areas" (EPA 2005). A comprehensive list of BMPs, including programmatic goals and activities, and future objectives and milestones is included in the State of Louisiana Water Quality Management Plan, Volume 6, Louisiana's Nonpoint Source Management, 2000.

Students applying storm drain markers

Household Chemicals

A host of biodegradable cleaners and other less-toxic chemicals are commercially available. Such alternative products typically contain chemicals that rapidly break down in soil and water into fewer toxic constituents, or they are reusable or recyclable. These include low-phosphate or phosphate-free detergents and water-based products. These alternative products can be used in combination with traditional chemicals as part of an integrated pest management program or for everyday household cleaning. Although there may be instances when it is necessary to use stronger chemicals (for example, to target bacteria), often a simple, milder cleanser will do the job.

Although alternative products are generally less harmful than commercial cleaners, it is still just as important to follow their instructions for proper storage and handling. Alternative products and homemade mixtures should be stored in clean, store-bought containers and properly labeled to avoid confusion with food or drink. The EPA's Source Reduction Alternatives around the Home, which is part of the Consumer Handbook for Reducing Solid Waste, provides a brief discussion of alternative cleaning methods as well as proper storage and handling procedures.

The key to preventing household chemicals from entering receiving waters is to educate the public about the importance of taking care when storing and disposing of everyday materials. Education can be used to inform the public on proper procedures for handling and disposing of household chemicals to prevent pollution and to instill a sense of responsibility for their actions and choices as consumers.

Storm drain marking

Storm drain marking involves labeling storm drain inlets with painted or prefabricated messages that warn citizens of the environmental hazards of dumping materials into storm drains. Marking projects are typically conducted by volunteer groups in cooperation with local authorities. The messages can be a simple phrase to remind passersby that the storm drains connect to local water bodies and that dumping pollutes those waters. Some specify which water body the inlet drains to or name the particular river, lake, or bayou. Common messages include, “No Dumping—Drains to Water Source,” “Drains to Bayou,” and “You Dump it; You Drink it, No Waste Here.”

Encourage responsible car washing practices

An appreciable amount of wash water laden with detergents, dirt, and automotive fluids can wash into the storm drain system or directly into receiving waters in urban areas. Stakeholders can reduce the impact of car washing on receiving waters by washing cars on grass or another permeable surface to filter dirt and detergents. Additionally, citizens should use a sponge and bucket to reduce the amount of wash water used and to allow it to be disposed of down a household drain that is connected to the sanitary sewer or onsite disposal system. Finally, low-phosphate detergents should be used to minimize the eutrophic effects of wash water in receiving waters.

Community car washes, such as those conducted for fundraisers may be a particularly large source of contaminated runoff. Some communities are experimenting with fundraiser registration, practices that block storm drains during community car washes, and the designation of pervious areas for the diversion of runoff.

Lawn conversion

Grasses are very water-hungry and labor-intensive plants compared to ground cover, flowers, shrubs, and trees. Therefore, to reduce the maintenance requirements of a lawn and address problem areas where turf is difficult to grow, property owners could identify areas where turf grass can be replaced with other types of plantings. These areas include lawn edges, frost pockets, exposed areas, dense shade, steep slopes such as along the banks of Bayou Lafourche, and wet, boggy areas. Replacement vegetation that is best suited to local conditions should be chosen to replace turf.

Recommendations for applicable plants are available from a local extension office. State specific cooperative extension service information is available from the Cooperative State Research, Education, and Extension Service (CSREES) at http://www.csrees.usda.gov.

Minimal fertilization

A lawn may require the addition of nutrients to promote or maintain healthy growth. A soil test can give you an accurate picture of the quality of your soil. Nutrients can be partly supplied by leaving a moderate amount of fine grass clippings on the lawn after mowing—these clippings can provide nearly half of the required nutrients to the lawn and they hold in moisture, speed decomposition, and relieve the burden of landfills to handle excess yard waste. Additional nutrients can be supplied with compost or commercial fertilizers that are of an organic or encapsulated nitrogen type, but they should be applied at or below the rates prescribed on the packaging. Compost or organic and encapsulated nitrogen fertilizers reduce the risk of nutrient leaching and have been shown to release nutrients more gradually. Slow-release fertilizers are also beneficial for reducing nitrogen losses from soils that are prone to leaching. Organic products offer the additional benefits of increasing soil condition and promoting the growth of desirable soil organisms.

Timing of fertilization is very important. Warm-season grasses generally benefit more from spring and summer fertilization. Fertilizers require water for activation; a light watering is usually enough (note that fertilizer should not be applied if rainfall is expected).

Excessive fertilization causes unwanted growth and the need to mow more often. Fertilizing at the wrong time of year may favor the growth of weeds rather than healthy turf. Excessive fertilization along with excessive watering can lead to the buildup of thatch that can increase insect and disease problems.

Weed control and tolerance

A property owner must decide how many weeds can be tolerated before action is taken to eradicate them. A few weeds will not substantially interrupt the continuity of the turf. The best way to keep weeds at bay is to maintain a healthy, dense lawn that shades the ground surface, preventing weed seedlings from taking root. However, if weeds do take hold, they should be dug or pulled out. Chemical herbicides should be used to spot-treat weeds, not applied universally. A local cooperative extension service should be consulted about the proper use of herbicides.

Pet wastes

When pet waste is not properly disposed of, it can wash into nearby water bodies or be carried by runoff into storm drains. Since most urban storm drains do not connect to treatment facilities, but rather drain directly into lakes and streams, untreated animal waste can become a significant source of runoff pollution. As pet waste decays in a water body, the degradation process uses oxygen and sometimes releases ammonia. Low oxygen levels and the presence of ammonia, combined with warm temperatures, can be toxic to fish and aquatic life. Pet waste also contains nutrients that promote weed and algae growth. Perhaps most importantly, pet waste carries microbes, such as bacteria, viruses, and parasites that can pose a health risk to humans and wildlife. For example, T. gondii can cause fatal brain infections in otters and muscle cysts in humans.

Pet owners have several options for properly managing pet waste. Collecting the waste and flushing it down the toilet, where it can be treated by a sewage treatment facility or onsite disposal system is the preferred method. Small quantities can also be buried in the yard, where the waste can decompose slowly. When buried, the waste should be at least 5 inches below the ground surface and away from water bodies and vegetable gardens. In public areas, the waste can be sealed in a plastic bag and thrown in the trash, which is legal in most areas.

Many communities implement pet waste management programs by posting signs in parks or other areas frequented by pet owners, sending mailings, and making public service announcements. Many communities have "pooper scooper" ordinances that govern pet waste clean-up. Some of these laws specifically require anyone who takes an animal off his or her property to carry a bag, shovel, or scoop. Any waste left by the animal must be cleaned up immediately. In addition to postings, many communities have installed "pet waste stations" in popular dog parks. These stations contain waste receptacles as well as a supply of waste collection bags, scoops, and shovels.

Trash

Regular cleaning and maintenance of storm water control infrastructure is necessary to prevent the accumulation of trash at control

Structural control for removing floating debris structures from becoming a hazard. It is important to understand that control strategies should not just transport trash to another water body but should also reduce the quantity of trash entering water bodies.

Fishing line waste container

There are two methods of trash control: source controls and structural controls. There are four source control types: community education, improved infrastructure, waste reduction, and cleanup campaigns. Community education, such as informing citizens about options for recycling and waste disposal and educating them about the consequences of littering, is one of the best ways to reduce the amount of trash that enters runoff control structures and receiving waters. Another topic that should be emphasized is proper trash storage and disposal. Improved infrastructure can include optimizing the location, number, and size of trash receptacles, recycling bins, and cigarette butt receptacles based on expected need. Waste reduction includes encouraging consumers to purchase products with less disposable packaging and encouraging manufacturers to reduce the amount of packaging they use. Finally, clean-up campaigns are an effective way to reduce trash.

Municipal projects such as street sweeping, receptacle servicing, and cleanup crews along roadsides can also be effective in preventing trash from accumulating and entering waterways. Municipalities should review their litter control program to determine if the number and placement of receptacles is adequate and if regular maintenance activities (e.g., sweeping, receptacle servicing) are preventing litter from entering receiving waters.

Structural controls include physical filtering structures and continuous deflection separation. Physical filtering structures concentrate diffuse, floating debris and trash and prevent it from traveling downstream. Some examples are trash racks, mesh nets, bar screens, and trash booms. Continuous deflection separation targets trash from storm flows during and after heavy precipitation and involves physical separation of solids and floatables from water in runoff detention structures.

Pervious pavement

Install runoff management practices in or adjacent to large parking areas

Retrofit practices can be installed near large parking lots to capture, detain, and/or treat runoff. Infiltration practices such as bioretention areas, porous pavement, sand filters, and underground vaults are good candidates.

Disconnect impervious areas

Roof downspouts can be disconnected from streets and culverts and runoff diverted over vegetated areas or infiltration systems (for treatment) or into cisterns or rain barrels for reuse. Also, roadway runoff can be converted to sheet flow and directed to vegetated buffers, infiltration devices, or other pervious areas.

Rooftop runoff also can be controlled with a vegetated roof cover. These systems consist of a high-quality waterproof membrane covered by drainage material, a planting medium, and vegetation. Vegetated roof covers use foliage and a lightweight soil mixture to absorb, filter, and detain rainfall. The systems are designed to control high-intensity storms by intercepting and retaining water until the rainfall peak passes. Additionally, vegetated roof covers improve insulation and reduce the amount of reflected solar radiation, resulting in lower temperatures in urban areas.

Use open swales in place of traditional storm drain systems

Grassed swales are an effective and natural means of conveying runoff. Because the water comes into contact with vegetation, the runoff velocity decreases, which promotes infiltration, reduces erosion, and lengthens time of concentration. Because grassed swales are wider and shallower than conventional channels, runoff is less concentrated. They are especially appropriate alongside roadways or on the border of a site. Swales can be combined with terraces and infiltration devices to enhance runoff retention. Swale installation requires a minimum amount of excavating and regrading. Vegetation should be established immediately to prevent excessive erosion; while vegetation is being established, geotextiles or turf reinforcement mats can be used to stabilize exposed soils in the swale.

Grassed swale in residential neighborhood

Protect sensitive areas

Areas that should be considered for preservation and restoration at sites with existing development include riparian areas, 100-year floodplains, wetlands, woodlands and valuable trees, and areas with permeable soils. Steep slopes and erosive soils should be protected and stabilized to the extent possible.

Reestablish riparian cover

Riparian cover is an essential component of the urban stream ecosystem. Riparian cover is necessary to stabilize banks, provide large woody debris and detritus, and provide shade to maintain water temperatures. Reestablishment of the riparian cover plant community along the stream network is often essential to achieve the goals and objectives of any water quality management program. This can entail active reforestation of native species, removal of exotic species, or changes in mowing operations to allow gradual succession.

On-lot storage practices

The term "on-lot storage" refers to a series of practices that are designed to contain runoff from individual lots. The purpose of most on-lot practices is to manage rooftop or parking area runoff.

The primary advantage of managing runoff from rooftops and parking lots is to disconnect these impervious surfaces, reducing the effective impervious cover in a watershed. Johnston et al. (2003) modeled the downstream hydrologic and economic impacts of on-site runoff storage based on flood risk reduction on property values and costs of storm drainage infrastructure. They found that use of reduced runoff practices provided property value benefits due to decreased flood risk of $21,600 to $36,300 per acre using parish-wide assessed values, or $17,540 to $29,240 per acre using U.S. Census Bureau census block median housing values.

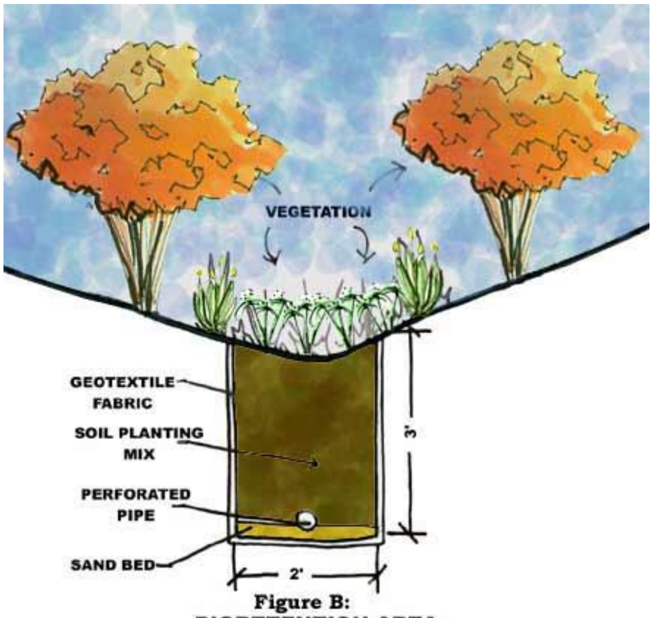


Figure B:
BIORETENTION AREA

Benefits in avoided costs for storm drainage infrastructure (road culverts) totaled $247 to $836 per developed acre.

Although there are many on-lot treatment options, they can all be classified into one of three categories: (1) practices that infiltrate runoff; (2) practices that divert runoff to a pervious area; and (3) practices that store runoff for later use. The best option depends on the goals of a community, the feasibility at a specific site, and the preferences of the property owner.

Rooftop Runoff

The practice most often used to infiltrate rooftop runoff is the dry well. In this design, the storm drain is directed to an underground rock-filled trench that is similar in design to an infiltration trench. French drains or Dutch drains can also be used for this purpose. In these designs, the relatively deep dry well is replaced with a long trench with a perforated pipe within the gravel bed to distribute flow throughout the length of the trench. Chamber systems, a widely marketed proprietary product, can be used in a similar manner. This may be particularly applicable in the Bayou Lafourche watershed where high water tables make deep well infiltration ineffective.

Runoff can be diverted to a pervious or treatment area using site grading or channels and berms. Treatment options can include grassed swales, bioretention cells, or filter strips. The bioretention design can be simplified for an on-lot application by limiting the pretreatment filter and in some cases eliminating the underdrain. Alternatively, rooftop runoff can simply be diverted to pervious lawn areas instead of discharging it directly to the street or a pipe drainage system.

Rain barrel

Practices that store rooftop runoff, such as cisterns, chambers, and rain barrels, are the simplest designs for on-lot systems. Some of these practices are available commercially and can be applied in a variety of site conditions. Stored water can be used to irrigate lawns or gardens, wash away debris, or even for non-potable use indoors.

Although most residential lots can incorporate on-lot treatment, the best option for a site depends on design constraints and the preferences of the homeowner. On-lot infiltration practices have the same restrictions regarding soils as other infiltration practices. If other design practices are used, such as bioretention or grassed swales, they need to meet the siting requirements of those sites. Of all of the practices, cisterns and rain barrels have the fewest site constraints. In order for the practice to be effective, however, homeowners need to have a use for the water stored in the practice, and the design must accommodate overflow.

Although these runoff management practices are simple compared with many others, their design needs to incorporate the same basic elements. Pretreatment is important for all of these practices to ensure that they do not become clogged with leaves or other debris. Infiltration practices may be preceded with a settling tank or, at a minimum, a grate or filter in the downspout to trap leaves and other debris. Rain barrels and cisterns often incorporate some sort of pretreatment, such as a mesh filter at the top of the barrel or cistern.

Infiltration and storage practices should incorporate some type of bypass so runoff from larger storms flows away from the house. With rain barrels or cisterns, this bypass may be a hose set at a high level within the device that directs runoff away from both the device and the building foundation. These practices also include a hose bib set at the bottom of the device so the homeowner can use the stored water for irrigation or other uses by attaching a standard garden hose to the hose bib.

Parking Lot Runoff

Standard parking lots typically drain rapidly through curb and gutter systems to prevent flooding. This practice, however, does little to improve water quality or protect receiving waters from high flows during and after storms. Innovative designs for parking lots incorporate pervious areas for drainage, whether at the perimeter or in various islands within the lot. These pervious areas should be designed to infiltrate runoff at rates that prevent excessive ponding, which could appear unsightly or create safety issues and nuisance mosquito habitat. In cases where existing soils have poor infiltration capacity, better-drained soils should be imported or perforated underdrains installed to store infiltrated runoff underground.

The use of large-diameter underground pipes constructed of concrete, corrugated steel, or high density polyethylene (HDPE) is becoming a more common practice for large parking areas such as shopping malls and mixed-use developments. These underground pipes and vaults as well as chamber systems can store large quantities of runoff that can be reused as needed or released at rates that will not damage natural conveyance systems.

Onsite Disposal System Management Measures

Onsite disposal systems are a necessary part of the human environment. Costs prohibit the practicality of every home and business being treated by a centralized wastewater treatment plant. Reducing the cumulative impact of these onsite systems requires a comprehensive evaluation of the science involved and the regulatory framework that provides oversight for the industry. Additional training and oversight is necessary to guarantee the functionality of each onsite disposal system. The combined effort of local and state governments can ensure that installers, inspectors, and users have the knowledge necessary to ensure systems are properly selected, installed, and maintained. These efforts will provide for improved treatment; protecting our waters, and improving our environment and quality of life.


Homes along Bayou Lafourche

The functionality of onsite disposal systems depends largely on the physical characteristics of the environment in which they are installed. Soil type, groundwater level, land use and many other factors can have a large impact on the type of system that is appropriate for a particular area. Because of this, local governments may be best suited for determining and enforcing the installation of the most applicable system for a narrow geographic area.

The following management measures have been adapted from the 2005 EPA guidance, "National Management Measures to Control Nonpoint Source Pollution from Urban Areas" In that document, EPA provides an in-depth review of the strategies that can be utilize to mitigate the impacts of past, present, and future Onsite Disposal Systems. The document can be viewed online via EPA's website at www.epa.gov.

When properly planned, designed, installed, operated, and maintained, Onsite Disposal Systems (OSDS) (also referred to as septic systems) can effectively remove or treat contaminants such as pathogens, biochemical oxygen demand (BOD), and nutrients in human sewage. However, many on-site systems are failing because of age, inappropriate design, hydraulic/pollutant overloading, or poor maintenance. Detrimental impacts from on-site systems can occur when they are sited in sensitive ecological areas (such as wellhead protection zones, near nitrogen/phosphorus limited waters, or near beaches or shellfish habitat) or when they are installed at densities that exceed the hydraulic and hydrologic assimilative capacities of regional soils and aquifers. Pollutants of concern from on-site systems include pathogens, nitrogen compounds (e.g., nitrates), phosphorus, BOD, and other chemicals.

Develop or maintain on-site wastewater treatment system (OWTS) permitting and installation programs that adequately protect surface water and ground water quality. Programs should include:

- A process to identify and protect sensitive areas (e.g., source water protection areas, nitrogen/phosphorus limited waters, shellfish habitat) and ensure that cumulative hydraulic discharges and mass pollutant loads from on-site systems do not impair surface or ground water;

- System selection, siting, design, and installation based on performance requirements, prescriptive technologies, protective setbacks, and separation distances that protect surface water and ground water resources;

- Education, training, licensing, and/or certification programs for system designers, site evaluators, permit writers, installers, inspectors, and other service providers; and

- Inspections of new on-site systems during and immediately following construction/installation to ensure that design and siting criteria are applied appropriately in the field.

Establish and implement management programs to ensure that newly permitted and existing onsite wastewater treatment systems are operated and maintained properly to prevent the impairment or degradation of surface and/or ground waters. On-site system operation and maintenance programs should include:

- System inventories and assessments of maintenance needs that provide management information regarding the types of systems in use and their location, capacity, installation date, owner, date of last inspection/service, and other data needed to support operation and maintenance oversight activities.

- Policies to ensure that on-site systems are managed, operated, and maintained to prevent degradation and impairment of surface and ground waters. These policies should include adequate authority to conduct inspections, revoke operating permits, and require pumping, repair, replacement, upgrade, or modification technologies when conditions indicate that surface and/or ground water resources might be adversely affected (e.g., eutrophication of surface waters, microbial or nitrate contamination of ground water).

- Periodic inspection and/or monitoring requirements to ensure that on-site systems are functioning properly. Inspection and monitoring programs should consider hydraulic, hydrologic, and mass pollutant loading impacts at both the site and watershed scales.

Requirements to ensure that residuals pumped from the tank (i.e., septage) are reused or disposed of in a manner that does not present significant risks to surface waters or ground water resources.

Grazing Management Measures

Farmers, scientist, and other groups have worked to develop a set of best management practices (BMPs) to help protect Louisiana's valuable waters. BMPs are practices used by agricultural producers to control the generation and delivery of pollutants from agricultural activities to water resources and thereby reduce the amount of agricultural

pollutants entering surface and ground waters (LSU AgCenter 2000). The Louisiana State University AgCenter has published a set of BMPs specifically targeted at reducing the impact of beef cattle production. The document, "Beef Production Best Management Practices" can be obtained through the LSU AgCenter website at www.lsuagcenter.com. A selection of BMPs is highlighted below. For a complete list of BMPs, contact your local United States Department of Agriculture (USDA) Service Center, LSU AgCenter parish office, or Louisiana Department of Agriculture and Forestry (LDAF) Conservation District.

Field Boarders & Filter Strips (NRCS Codes 386 & 393)

Field boarders and filter strips are areas of grasses or other close-growing vegetation planted around fields and along drainage ways, streams and other bodies of water. They are designed to reduce sediment, organic material, nutrients and chemicals carried in runoff. In a properly designed filter strip, water flows evenly through the strip, slowing the runoff velocity and allowing contaminants to settle from the water. In addition, where filter strips are established, fertilizers and herbicides no longer need to be applied right next to susceptible water sources. Filter strips also increase wildlife habitat. Soil particles (sediment) settle from runoff water when flow is slowed by passing through a filter strip. (LSU AgCenter 2002)

Trough or Tank (NRCS Code 614)

By installing a trough or tank to supply water for livestock, farmers can provide a drinking source at specific locations that will protect vegetative cover. This practice reduces or eliminates the need for livestock to be in streams. It also reduces health hazards for livestock and reduces livestock waste in waterways. (LSU AgCenter 2002)

Riparian Forest Buffer (NRCS Code 319)

This is an area of trees, shrubs and other vegetation located adjacent to and uphill from water bodies. This practice may be applied in a conservation management system to supplement one or more of the following:

- To create shade to lower water temperature, improving habitat for aquatic organisms.
- To remove, reduce or buffer the effects of nutrients, sediment, organic material and other pollutants before entry into surface water and groundwater recharge systems.

This practice applies to cropland, hayland, rangeland, forestland and pastureland areas adjacent to permanent or intermittent streams, lakes, rivers, ponds, wetlands and areas with groundwater recharge where water quality is impaired or where there is a high potential of water quality impairment. (LSU AgCenter 2002)

Livestock Exclusion (NRCS Code 472)

The purpose of use exclusion is to protect, maintain or improve the quantity and quality of the natural resources by excluding animals, people or vehicles from an area. The purpose includes aesthetic resources as well as human health and safety. The practice is used in areas where vegetation establishment or maintenance is a concern. Protecting vegetation is often essential to conserving other natural resources. The barriers constructed must be adequate to prevent, restrict or control use by target animals, vehicles or people. The barriers are usually fences, but they may be natural and artificial structures such as logs, boulders, earth fill, gates, signs, etc. (LSU AgCenter 2002)

Nutrient Management and Comprehensive Nutrient Management Plans

Stakeholders who fertilize pasturelands should refer to the **Nutrient Management** and **Comprehensive Nutrient Management Plans** discussions in the **Agriculture Management Measures** section presented earlier in this document.

Implementing Change

Implementation of management measures, BMPs, and conservation practices to reduce the nonpoint source pollution in the Upper Bayou Lafourche Watershed will require programs that provide technical assistance, funding, incentives, and foster a sense of stewardship. Many programs designed to assist stakeholders are already in place. The USDA and NRCS are federal government agencies that have several programs made available by way of the Farm Security and Rural Investment Act of 2002. These programs are made available through the local Soil and Water Conservation Districts (SWCD).

Parish-wide cooperation and coordination will be necessary to protect the water quality of Bayou Lafourche. Water Quality Management in the Bayou Lafourche Watershed is especially challenging due to the level of alteration that has occurred since immigrants first developed the land. Though challenging, this is an opportunity for leaders, officials, and stakeholders to come together with a shared interest in achieving a common goal. The watershed approach helps foster new levels of cooperation and coordination, which are necessary to successfully control nonpoint source pollution and protect this and ecological cultural treasure.

Public Participation

Public education and voluntary action are vital components of watershed protection and water quality improvement. Citizens, particularly property owners, should be informed of the objectives for implementing BMPs, the benefits to the community and to themselves, and ways in which they can participate. Citizens generally respond positively when they have an understanding of what is occurring and why. Conversely, the public may react negatively to programs or activities to implement BMPs when they are poorly informed about why they are needed. Public awareness affects the acceptability of mandatory controls, the effectiveness of voluntary measures, and the degree of support provided by elected officials. A public education campaign can improve the feasibility of implementing BMPs to protect water quality and is critical for effective implementation. Finally, an informed public will be helpful in supporting and assisting monitoring and enforcement programs.

Presently, the only requirement for public participation is a 30–day comment period after the TMDL is issued. Therefore, stakeholders are informed by mailed public notices and notices in newspapers. Ultimately, the public needs to be the most important part of the implementation of TMDLs, especially in the arena of nonpoint source pollution where there are few regulations. This is one of the areas where programs such as Master Farmer will be beneficial in providing information to landowners and farmers while building participation. Bayou Lafourche is home to a culturally, socially, and historically diverse population. The bayou defined the history of the region and continues to characterize the communities of today. This diversity of knowledge and ideas makes cooperation between stakeholders an integral part of successful action.

Regulatory Authority

Federal Authority

Section 319 of the Clean Water Act (PL 100-4, February 4, 1987) was enacted to specifically address problems attributed to nonpoint sources of pollution. Its objective is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters (Sec. 101; PL 100-4). The CWA instructed the Governor of each State to prepare and submit a Nonpoint Source Management Program for reduction and control of pollution from nonpoint sources to navigable waters within the State by implementation of a four-year plan (submitted within 18 months of the day of enactment).

State Authority

The LDEQ antidegradation policy (LAC 33: IX.1109.A) includes the following statements that are applicable to this watershed: "No lowering of water quality will be allowed in waters where standards for the designated water uses are not currently being attained. ... The administrative authority will not approve any wastewater discharge or certify any activity for federal permit that would impair water quality or use of state waters."

In response to the federal law, the State of Louisiana passed Revised Statute 30:2011, signed by the Governor in 1987 as Act 272. Act 272 designated the Louisiana Department of Environmental Quality as the lead agency for development and implementation of the State's Nonpoint Source Management Plan. The Louisiana Revised Statutes R.S. 30:2011.D (20) includes the following provision as the authority for LDEQ to implement the State's NPS Program.

"To develop and implement a non-point source management and ground water quality protection program and a conservation and management plan for estuaries, to receive federal funds for this purpose and provide matching state funds when required, and to comply with terms and conditions necessary to receive federal grants. The nonpoint source conservation and management plan, the groundwater protection plan, and the plan for estuaries shall be developed in coordination with, and with the concurrence of the appropriate state agencies, including but not limited to, the Department of Natural Resources, the Department of Wildlife and Fisheries, the Department of Agriculture and Forestry, and the State Soil and Water Conservation Committee in those areas pertaining to their respective jurisdictions."

DEQ Actions

DEQ LOUISIANA

The Louisiana Department of Environmental Quality is presently designated the lead agency for implementation of the Louisiana Nonpoint Source Program. The LDEQ Nonpoint Source Unit manages USEPA §319(h) funds to assist in implementation of BMPs and to address water quality problems on subsegments listed on the §303(d) list or those subsegments which are located within Category I Watersheds as identified under the Unified Watershed Assessment of the Clean Water Action Plan. USEPA §319(h) funds are utilized to sponsor cost sharing, monitoring, and education projects. These monies are available to all private, for profit, and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including: cities, counties, tribal entities, federal agencies, or agencies of the State. Presently, LDEQ is cooperating with such entities on approximately 60 nonpoint source projects, which are active throughout the state.

SOURCE WATER PROTECTION PROGRAM

LDEQ is the lead agency for implementation of Louisiana's Source Water Protection Program. The goal of this program is to protect sources of public drinking water. Bayou Lafourche is the drinking water source for approximately 173,000 people from four water systems located in Assumption, Lafourche, and Terrebonne Parishes. Also, one water system serving approximately 33,500 people in Terrebonne Parish must occasionally introduce water from Bayou Lafourche into its water system when its main water sources receive an influx of saltwater from the Gulf of Mexico. Additionally, the intake for one public water system in Ascension Parish which serves a population of approximately 16,000 is located in Bayou Lafourche near the pump station at the Mississippi River. Bayou Lafourche is a major supplier of potable water for these parishes and is the sole provider of water for Assumption and Lafourche Parish.

LDEQ is scheduled to implement its Source Water Protection Program in Ascension Parish, and has already implemented a program in Assumption, Lafourche and Terrebonne Parish. LDEQ has developed a working relationship with local citizens, water system personnel, and local government to protect their source of drinking water, Bayou Lafourche. A public education/public awareness campaign was conducted and a committee made up of local volunteers has been formed. The committee is made up of concerned citizens, water system personnel, and local government officials. LDEQ has educated the committee on source water protection, goals of the program, and operation of the committee. Working goals for the committee and LDEQ were formed based on input from local citizens in the form of a survey/questionnaire, by communication with local citizens during the public awareness campaign, and through input on areas of concern from committee members.

LDEQ had previously identified potential sources of contamination for sources of public drinking water in Louisiana. Committee members and LDEQ are currently educating potential contributors about these possible sources of contamination in Assumption, Lafourche, and Terrebonne Parishes. As facilities that may contribute to contamination are visited, they are made aware that they are located near a drinking water source, and they are given pertinent fact sheets on best management practices to prevent pollution from getting into the their own drinking water source, Bayou Lafourche. Of the facilities being visited, 219 are located within the Bayou Lafourche watershed. Since urban runoff has been identified as a significant contributor of nonpoint source pollution into Bayou Lafourche, it is important that these facilities know that prudent operation onsite is important so that contaminants do not run off their premises and in the bayou.

LDEQ is working with the committee and local officials to address fecal coliform impairment in Bayou Lafourche. Onsite treatment systems and unpermitted sewage discharges have been cited as two of the potential sources of fecal coliform loading in the bayou. Consequently, the committee decided their focus should be on malfunctioning onsite treatment systems and unpermitted sewage discharges. LDEQ is in the process of developing an ordinance (with committee input) to present to the parish governments of Assumption, Lafourche, and Terrebonne Parishes. The ordinance would provide a local mechanism to address the maintenance of onsite treatment systems and demolition, removal, replacement, or repair of malfunctioning or improper systems. LDEQ will also compare the list of sewage treatment systems in the local LDHH Regional Sanitarian's database to the list of sewage treatment systems permitted by LDEQ to ensure all systems are permitted.

Other goals may be developed as the committee continues meeting which will further address pollution prevention for the area's source water, including Bayou Lafourche.

As stated by EPA, "one of the benefits of source water protection is to assure that public water systems do not have to provide more drinking water treatment other than that necessary to address naturally occurring pollutant concentration." Disinfection byproducts are chemical, organic and inorganic substances that can form during a reaction of a disinfectant (chlorine) with naturally present organic matter in water such as decomposed plant matter. Disinfection byproducts are harmful to human health and as a higher amount of drinking water disinfectant is required, it results in more disinfection byproducts being formed. High amounts of fecal coliform require higher amounts of disinfectant resulting in the need to address disinfection byproducts. High fecal coliform needs to be addressed by focusing on onsite treatment systems and unpermitted systems. Resolution of the problem is a public health benefit, reduces expenses for drinking water treatment, and improves water quality in the bayou for everyone.

Actions by Other Agencies

The U.S. Department of Agriculture (USDA) and Natural Resource Conservation Service (NRCS) offer landowners financial, technical and educational assistance to implement conservation practices and/or BMPs on privately owned land to reduce soil erosion, improve water quality, and enhance crop land, forest land, wetlands, grazing lands and wildlife habitat. The 2003 Farm Bill provides funding to various conservation programs for each state by way of the NRCS and local Soil and Water Conservation Districts (SWCD). The following includes a brief summary of the programs available through the local SWCD under the oversight of USDA and NRCS. The descriptions of the programs are general and are subject to change.

2003 Farm Bill Conservations Programs and Potential Funding Sources:

Bottomland Timber Establishment on Wetlands Program. This program provides annual payments and cost-share assistance to establish bottomland hardwood trees and shrubs. Currently 30,000 acres in Louisiana are considered eligible for this program.

Wildlife Habitat Incentive Program (WHIP) provides 75% - 90% cost share for the costs of wildlife habitat restoration and enhancement on private lands. Eligible to private property owners and lessees for installing riparian buffers, native pine & hardwoods, wildlife corridors, and other wildlife enhancing measures, 5 – 10 year contracts.

Wetland Reserve Program (WRP) is a voluntary program for wetland restoration, enhancement, and protection on private lands. WRP provides annual payments and restoration costs for 10 year, 30 year, or perpetual easements on prior converted wetlands. Louisiana leads the US in WRP participation. The 2002 Farm Bill raised total funding allocation to 1.5 billion and expanded the program to purchase long-term easements and provide cost sharing to agriculture producers.

Conservation Reserve Program (CRP)
The 1985 Farm Bill established CRP as a voluntary program to protect highly erodible and environmentally sensitive lands. This program extends a pilot sub-program called the Conservation Reserve Enhancement program and should enhance rural environments by improving soil, water and wildlife quality.

Environmental Quality Incentive Program (EQIP) provides 75% - 90% cost share for environmentally beneficial structural and management alterations, primarily 60% to livestock operations. Applications are prioritized for benefits. Considered the “Working Lands” program.

Conservation Security Program (CSP) is a new national incentive payment program for maintaining and increasing farm and ranch stewardship practices. The CSP is designed to correct a policy disincentive in which independently conducted resource stewardship has disqualified many farmers from receiving conservation program assistance. The program features an optional “tiered” level of farmer participation where higher tiers receive greater funding for greater conservation practices.

Farmland Protection Program (FPP) provides funding to states, tribes, or local governments and to nonprofit organizations to help purchase development rights and protect farmlands with prime, unique, or productive soil; historical or archaeological significance; or farmlands threatened by urban sprawl. Louisiana does not currently have any FPP contracts.

Grassland Reserve Program (GRP) is a new program to enroll up to 2 million acres of virgin and improved pastureland. GRP easements would be divided 40/60 between agreements of 10, 15, or 20-years and agreements and easements for 30-years and permanent easements to restore grassland, rangeland, and pasture through annual rental payments.

Small Watershed Rehabilitation Program (SWRP) provides essential funding for the rehabilitation of aging small watershed impoundments and dams that have been constructed over the past 50 years.

In addition to the programs mentioned, the following organizations have signed a Memorandum of Understanding (MOU) with LDEQ within the state's NPS Management Plan that each will aid LDEQ in achieving the goals of the management plan:

Louisiana Department of Agriculture and Forestry
Louisiana Department of Health and Hospitals
Louisiana Department of Wildlife and Fisheries
Louisiana Department of Transportation and Development
Louisiana Department of Natural Resources
Louisiana State University Agricultural Center
Natural Resources Conservation Service
USDA – Farm Services Agency
Louisiana Forestry Association
US Fish and Wildlife Service
USDA Forest Service
US Army Corps of Engineers
US Geological Survey
Federal Emergency Management Agency
Louisiana Farm Bureau Federation

Master Farmer Program

The Master Farmer Program (developed by Louisiana State University Agricultural Center) encourages on-the-ground BMP implementation with a focus on environmental stewardship. The LSU AgCenter is promoting the Master Farmer Program to improve environmental stewardship through voluntary, effective, and economically achievable BMPs. The program is implemented through a multi-agency/organization partnership including the Louisiana Farm Bureau (LFBF), the Natural Resources Conservation Service (NRCS), the Louisiana Cooperative Extension Service (LCES), USDA-Agriculture Research Service (ARS), LDEQ, and agricultural producers.

The Master Farmer Program has three components: environmental stewardship, agricultural production, and farm management. The environmental stewardship component has three phases. Phase I focuses on environmental education and implementation of crop-specific BMPs. Phase II of the environmental component includes in-the-field viewing of implemented BMPs on Model Farms. Phase III involves the development and implementation of farm-specific, comprehensive conservation plans by the participants. A member must participate in all three phases in order to gain program status and receive the distinction of being considered a master farmer.

This program helps to initiate and encourage the use of BMPs throughout the Louisiana. Participants set an example for the rest of the agricultural community and work closely with NRCS staff and other Master Farmers to identify potential problem areas in the watershed. Farmers receive information on new and innovative ways to reduce soil and nutrient loss from their fields and are kept informed of the water quality monitoring occurring in the watershed and alerted of any degradation or improvements.

Master Logger Program

The master logger program served as a model for development of the master farmer program, and has been very successful at educating foresters on BMP implementation. This program was developed by the Louisiana Forestry along with the Louisiana Department of Agriculture and Forestry - Office of Forestry.

Tracking and Evaluation

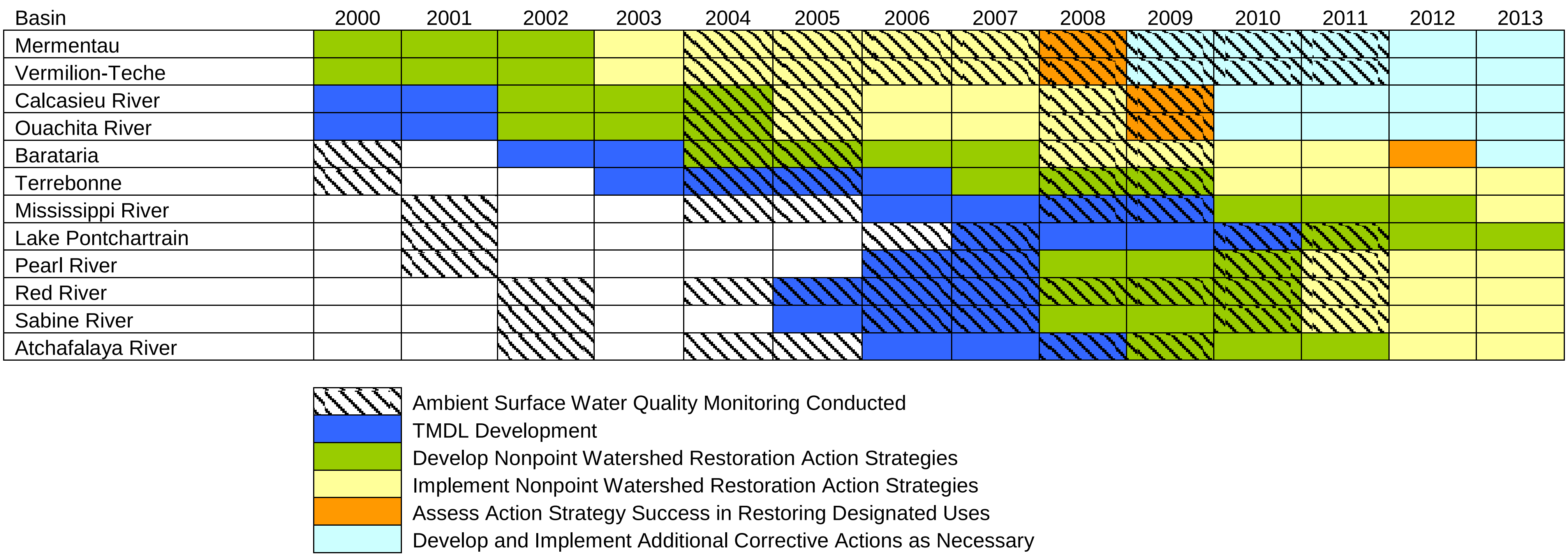
The Louisiana Nonpoint Management Plan stipulates program tracking at multiple levels to determine if the watershed approach is an effective method to reduce nonpoint source pollution and improve water quality:

1. Tracking of actions outlined with the Watershed Restoration Action Strategy (short-term)
2. Tracking of BMPs implemented as a result of Section 319, EQIP, or other sources of cost-share and technical assistance within the watershed (short term);
3. Tracking progress in reducing nonpoint source pollutants, such as solids, nutrients, and organic carbon from the various land uses (forestry, poultry) within the watershed (short-term);
4. Tracking water quality improvement in the bayou (i.e. decreases in total organic carbon, total dissolved oxygen) (short and long term)
5. Documenting results of the tracking to the Nonpoint Source Interagency Committee, residents within the watershed, and EPA (short and long term);
6. Submitting Semi-annual and annual reports to EPA summarizing results of the watershed restoration actions (short and long term)
7. Updating LDEQ’s web-site to include information on the progress made in watershed restoration actions, nonpoint source pollutant load reductions, and water quality improvement in the bayou (short and long term).

Implementation Timeline

The development and implementation of watershed management plans follows Louisiana's court-ordered TMDL schedule. After a TMDL has been developed for a specific water body subsegment, the Nonpoint Source Program begins work on a watershed management plan. Once completed, that plan is implemented through the cooperation of local, regional, state, and federal partners and through the Nonpoint Source Program at LDEQ. The Department of Environmental Quality's ambient sampling program works on a rotating basis, sampling each watershed basin every four years. The data from the ambient sampling program is used to evaluate the effectiveness of the management plan implementation. Management actions are adapted as necessary to meet changing conditions in the watershed. The table below outlines the watershed implementation schedule for each basin in Louisiana. The schedule indicates that the Bayou Lafourche Watershed (in the Barataria Basin) will begin the implementation phase in 2008, after the completion of this watershed management plan.

Louisiana TMDL Implementation Schedule



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Appendix A – Water Quality Data

Water quality data for Bayou Lafourche is available from five LDEQ ambient surface water quality monitoring stations. These stations include:

Site 0023	Bayou Lafourche 1 mile below Donaldsonville
Site 0293	Bayou Lafourche at Thibodaux Canal Boulevard in Thibodaux
Site 1112	Bayou Lafourche at US 90 bridge in Raceland
Site 0294	Bayou Lafourche at Vacherie Street in Lockport
Site 0111	Bayou Lafourche at LA 308 bridge in Larose

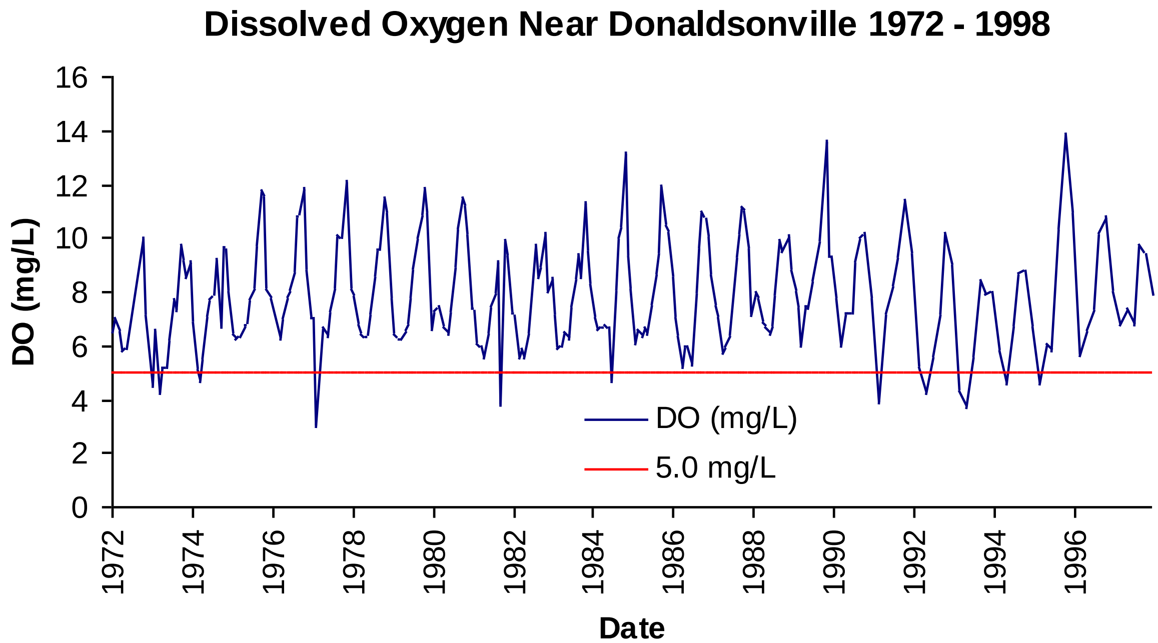
Data is available for a variety of parameters and dates from the five monitoring stations.

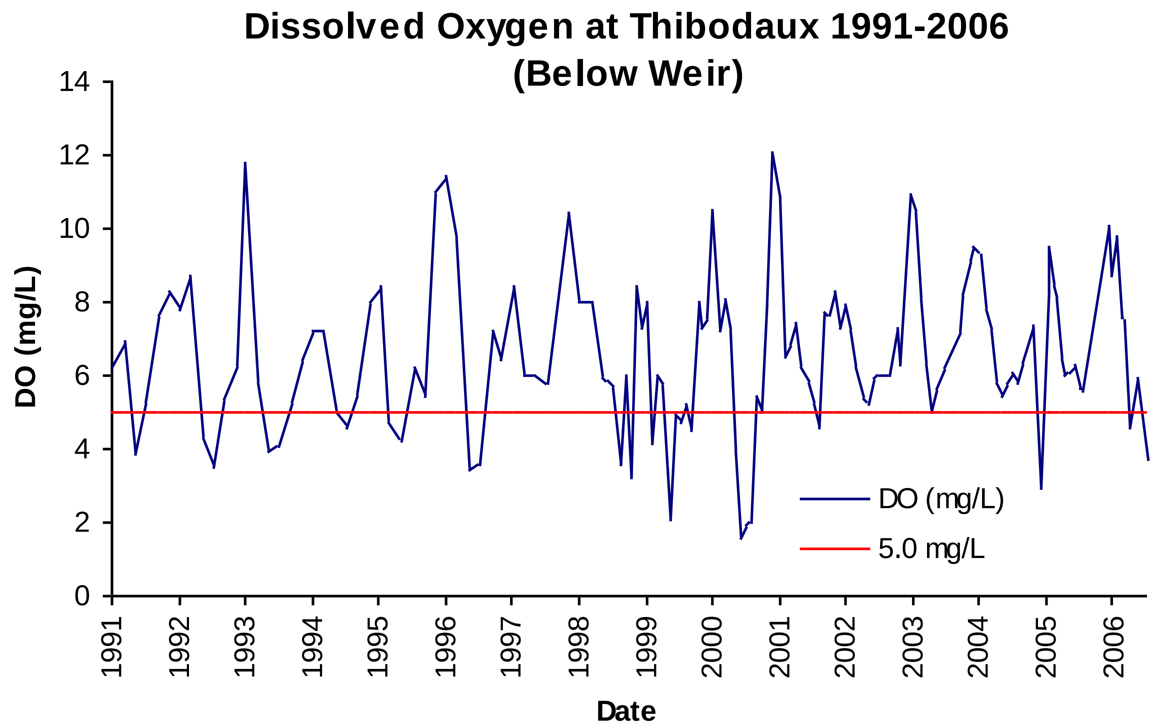
In the graphs included in this appendix, the blue or green lines represent the data for a specific parameter, and red lines represent the criteria for that parameter.

Dissolved Oxygen

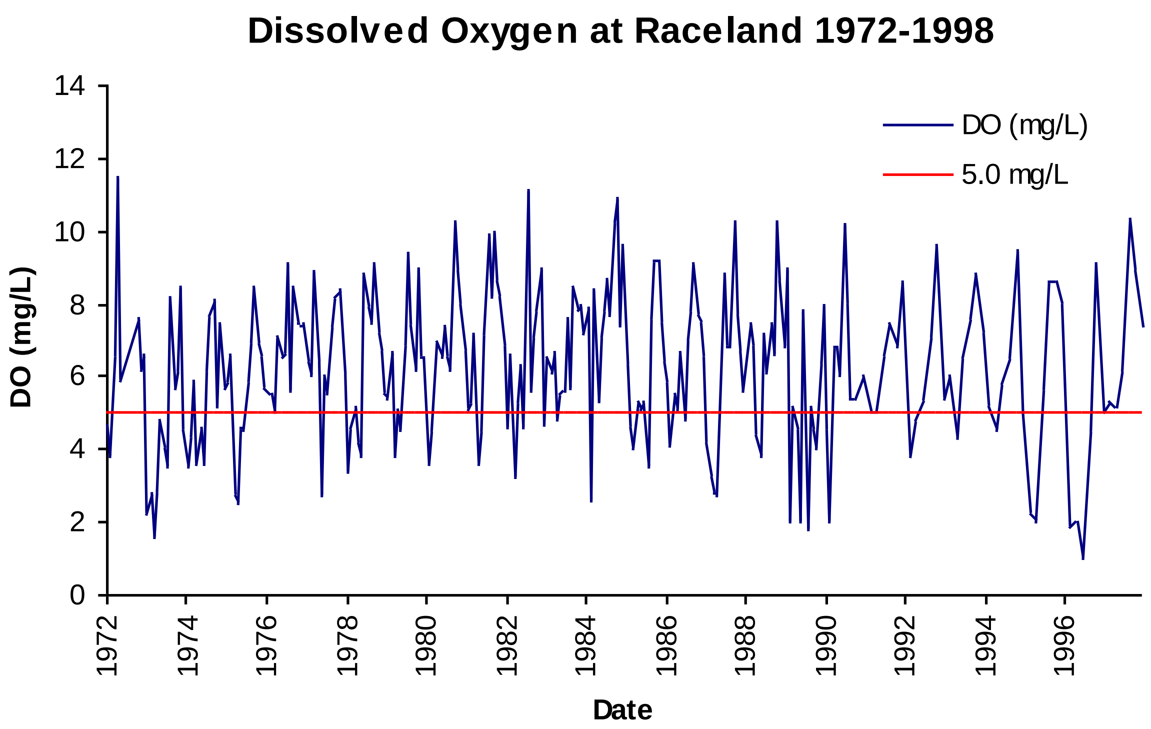
Dissolved oxygen criteria for Bayou Lafourche represent the general minimum criteria for fresh water. Naturally occurring variations below the criterion specified may occur for short periods. These variations reflect such natural phenomena as the reduction in photosynthetic activity and oxygen production by plants during hours of darkness. However, no waste discharge or human activity should lower the DO concentrations below the specified minimum. These DO criteria are designated to protect indigenous wildlife and aquatic life species associated with the aquatic environment.

For a diversified population of fresh warm water biota including sport fish, the DO concentrations should be at or above 5 mg/L. Bayou Lafourche is listed in the Louisiana Water Quality Inventory Integrated Report as being impaired for fish and wildlife propagation due to recurring violations of dissolved oxygen criteria. The majority of data shows a seasonal variability in dissolved oxygen concentrations with winter months exhibiting dissolved oxygen well above the 5.0 mg/L criteria, and diminished summer concentrations that regularly dip below the criteria. Higher summer temperatures reduce the solubility of oxygen in water, and increased productivity consumes oxygen at higher levels. These characteristics make water quality management measures especially important in summer months when low dissolved oxygen concentrations are more likely.

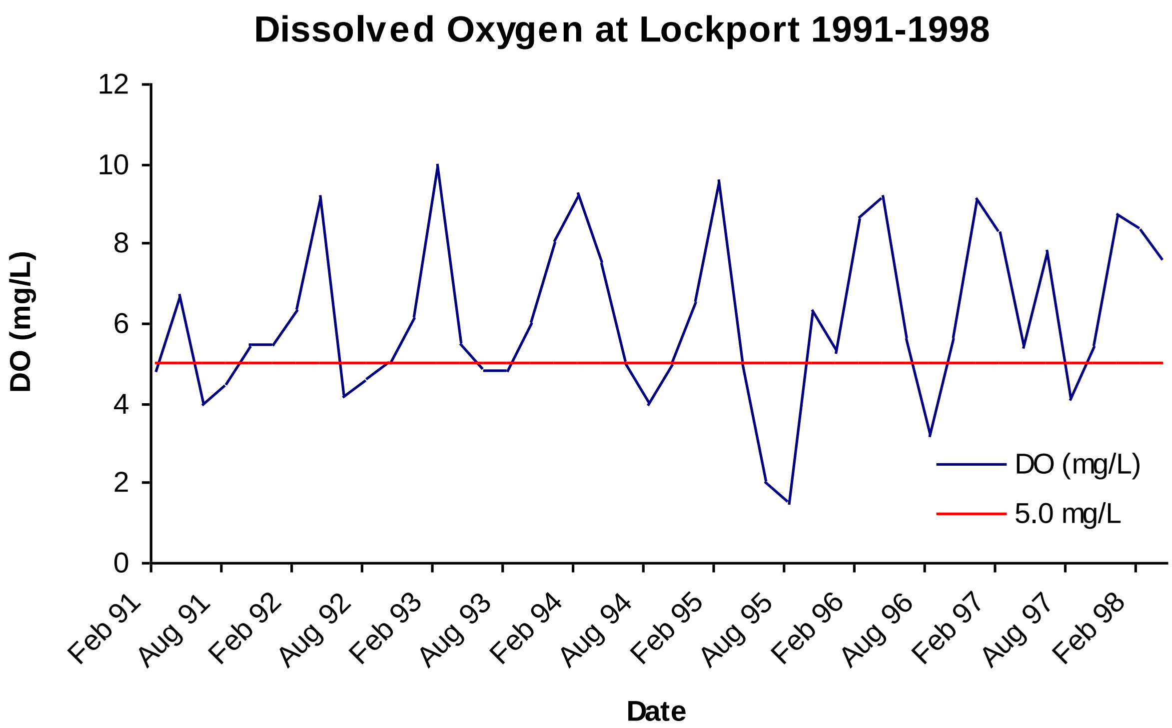

Dissolved Oxygen Near Donaldsonville 1972 - 1998
DO (mg/L)
0
2
4
6
8
10
12
14
16
1972
1974
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
Date
DO (mg/L)
5.0 mg/L


Dissolved Oxygen at Thibodaux 1991-2006
(Below Weir)
DO (mg/L)
0
2
4
6
8
10
12
14
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Date
DO (mg/L)
5.0 mg/L

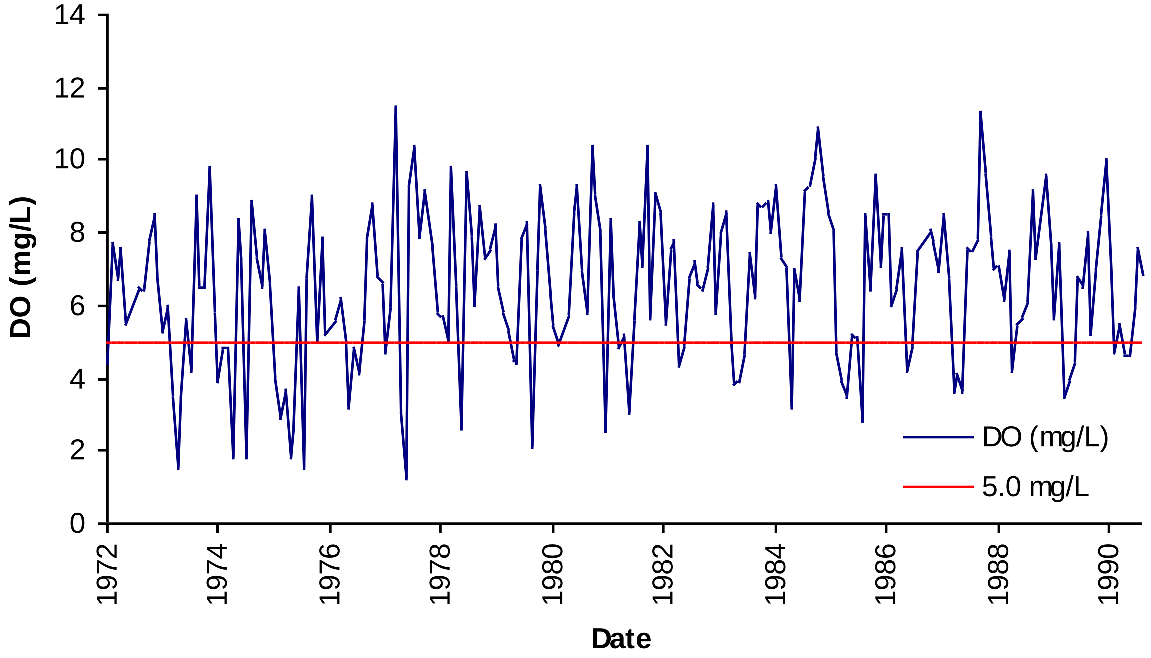
Dissolved Oxygen at Raceland 1972-1998



Dissolved Oxygen at Lockport 1991-1998

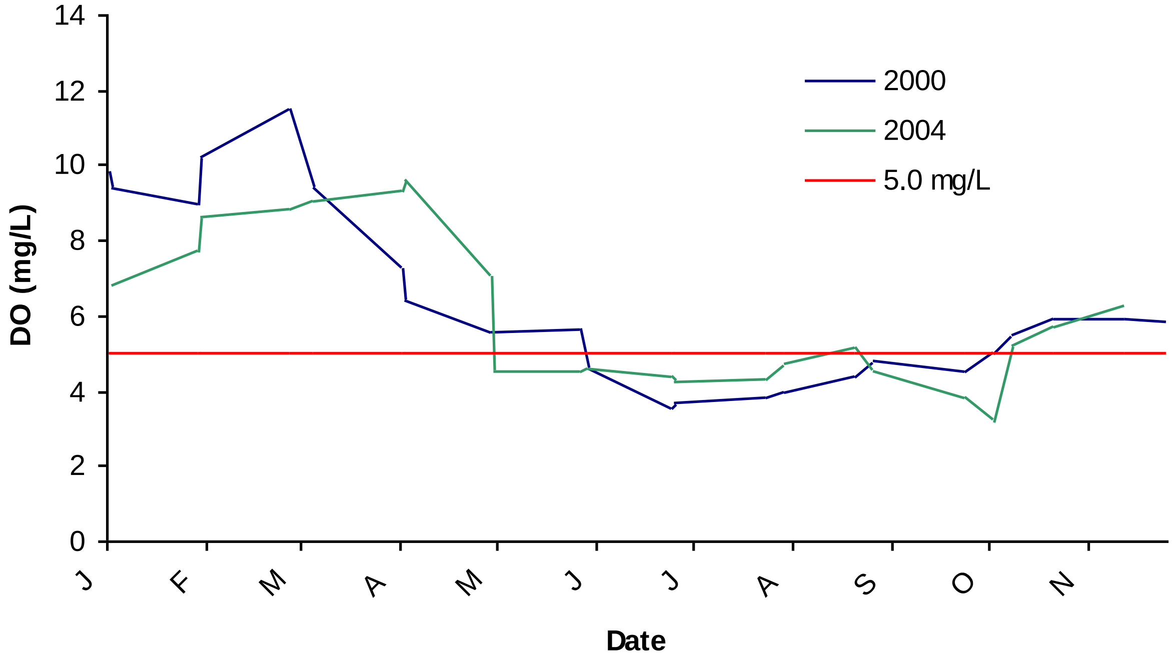


Dissolved Oxygen at Larose 1972-1990



When two years of data are compared side by side (as they are below) the seasonal variation is evident. The dissolved oxygen concentrations fluctuate in a similar pattern for both years.

Dissolved Oxygen at Larose 2000 & 2004



Bacteria

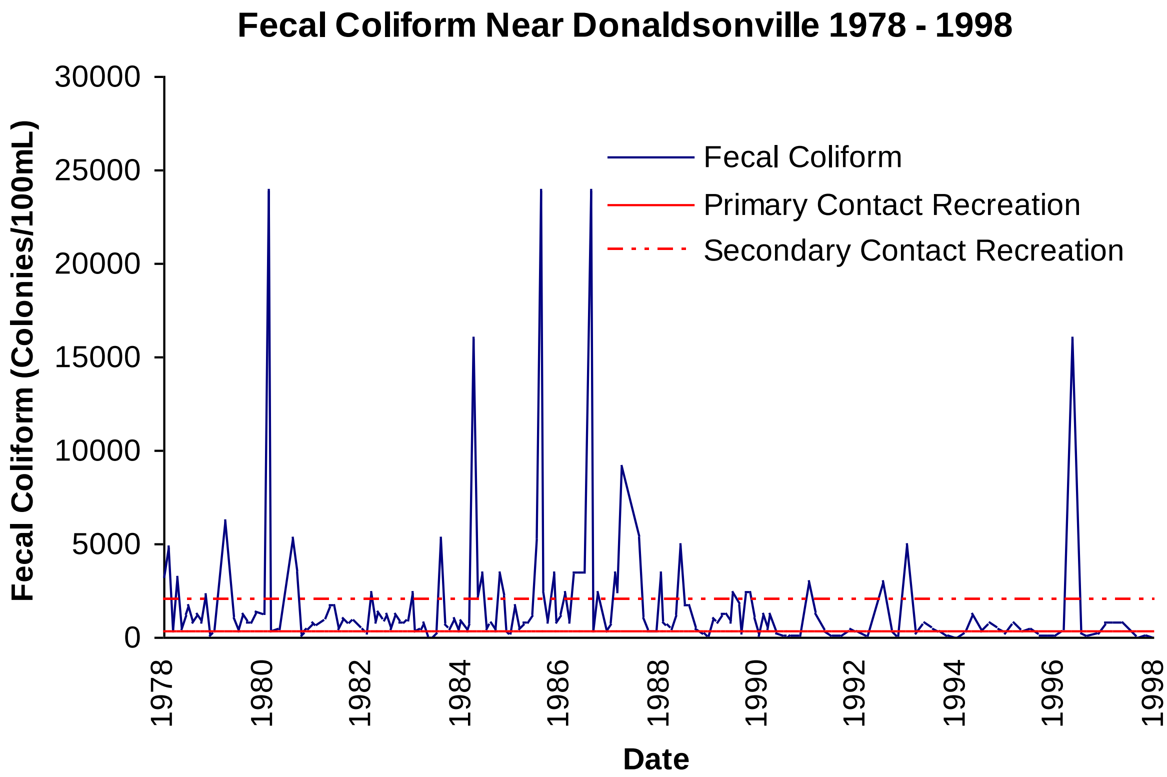
Bacteria criteria are established to protect water quality commensurate with the most stringent designated use assigned to the subsegment. In Bayou Lafourche, the most stringent designed use during the period of May 1 through October 31 is primary contact recreation. From November 1 through April 31, secondary contact recreation criteria apply.

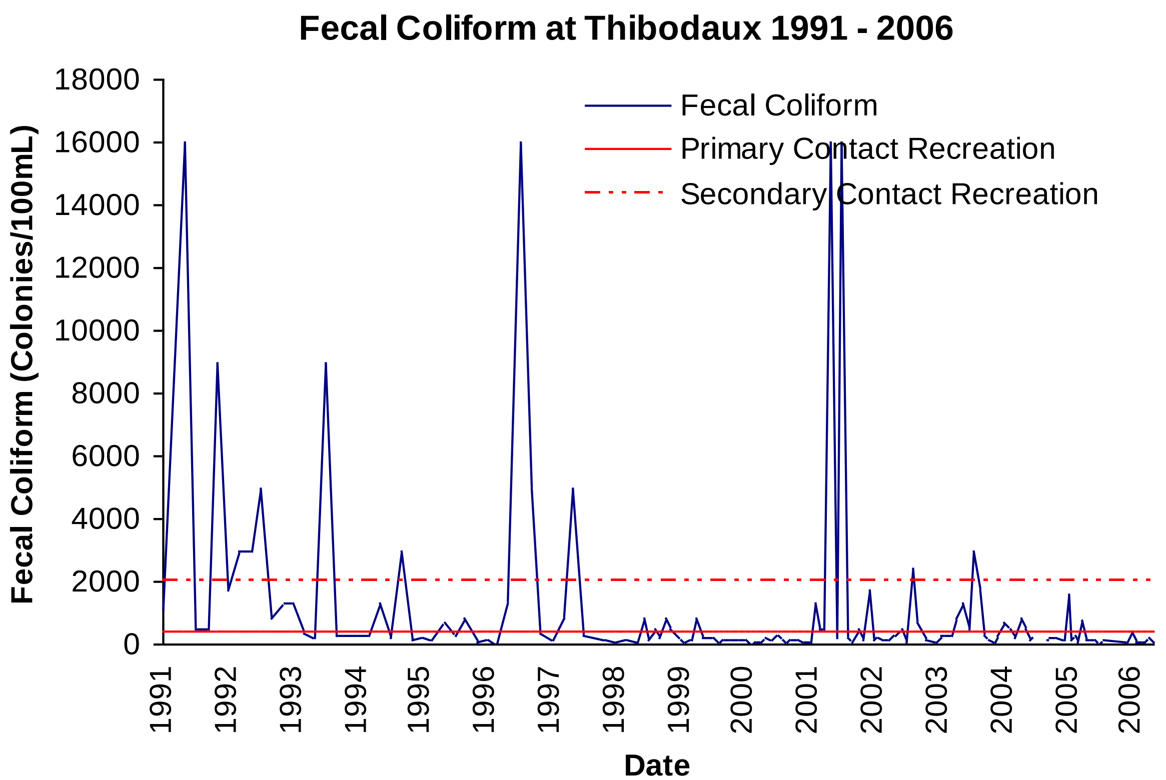
Primary contact recreation: No more than 25 percent of the total samples collected on a monthly basis shall exceed a fecal coliform density of 400/100 mL. This primary contact recreation criterion shall apply only during the defined recreational period of May 1 through October 31.

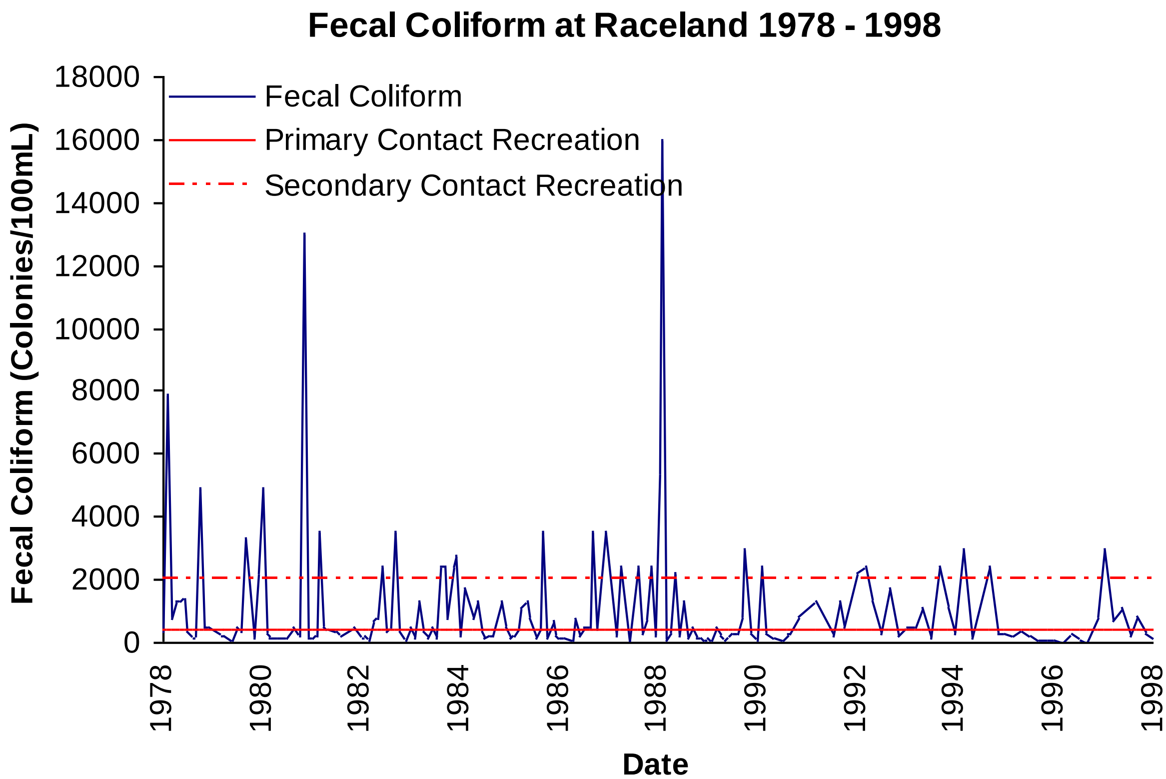
Secondary contact recreation: No more than 25 percent of the total samples collected on a monthly or near monthly basis shall exceed a fecal coliform density of 2,000/100 mL. In Bayou Lafourche, this secondary contact recreation criterion applies year round.

Drinking water supply: No more than 30 percent of the total samples collected on a monthly or near-monthly basis shall exceed a fecal coliform density of 2,000/100 mL.

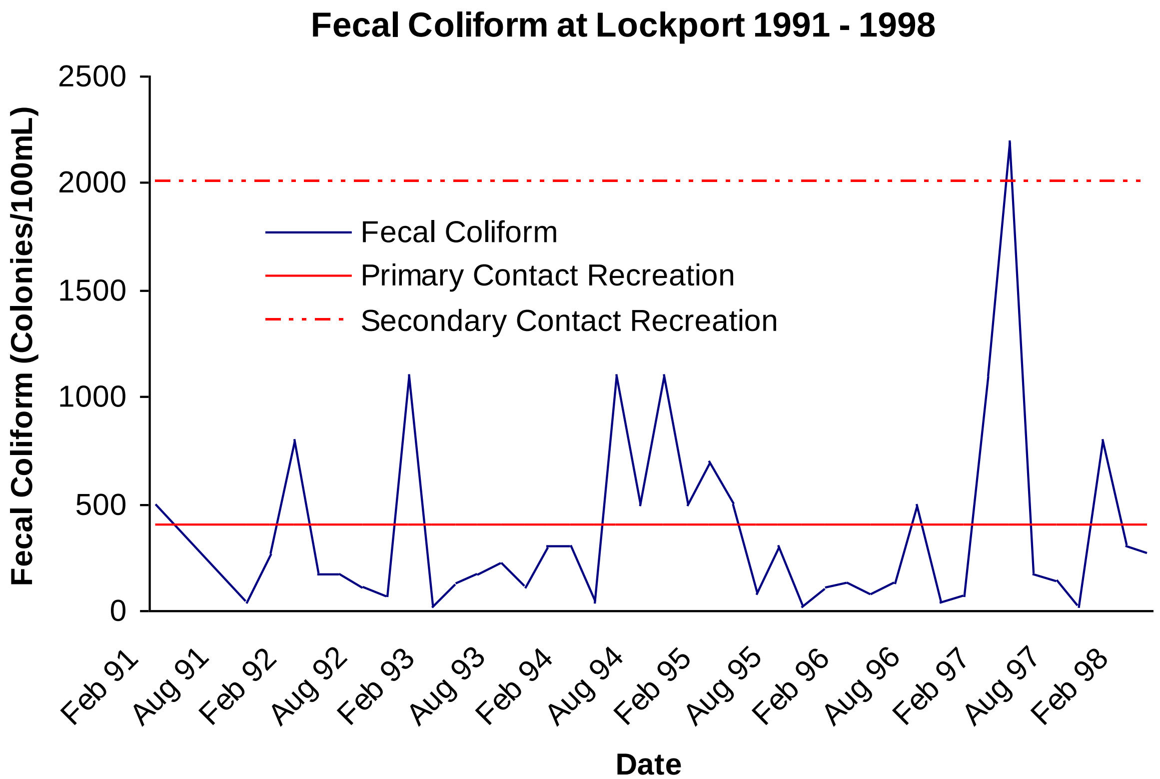
Bayou Lafourche is listed in the Louisiana Water Quality Inventory Integrated Report as being impaired for primary contact recreation due to recurring violations of fecal coliform criteria. Unlike dissolved oxygen, data shows no seasonal pattern in fecal coliform concentrations. While dissolved oxygen fluctuations are driven largely by seasonal temperature changes, fecal coliform fluctuations are more likely caused by rainfall events that result in sewer and onsite disposal system effluent being washed into Bayou Lafourche, as well as domestic and wild animal waste being carried by runoff.


Fecal Coliform Near Donaldsonville 1978 - 1998
Fecal Coliform (Colonies/100mL)
30000
25000
20000
15000
10000
5000
0
Fecal Coliform
Primary Contact Recreation
Secondary Contact Recreation
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
Date

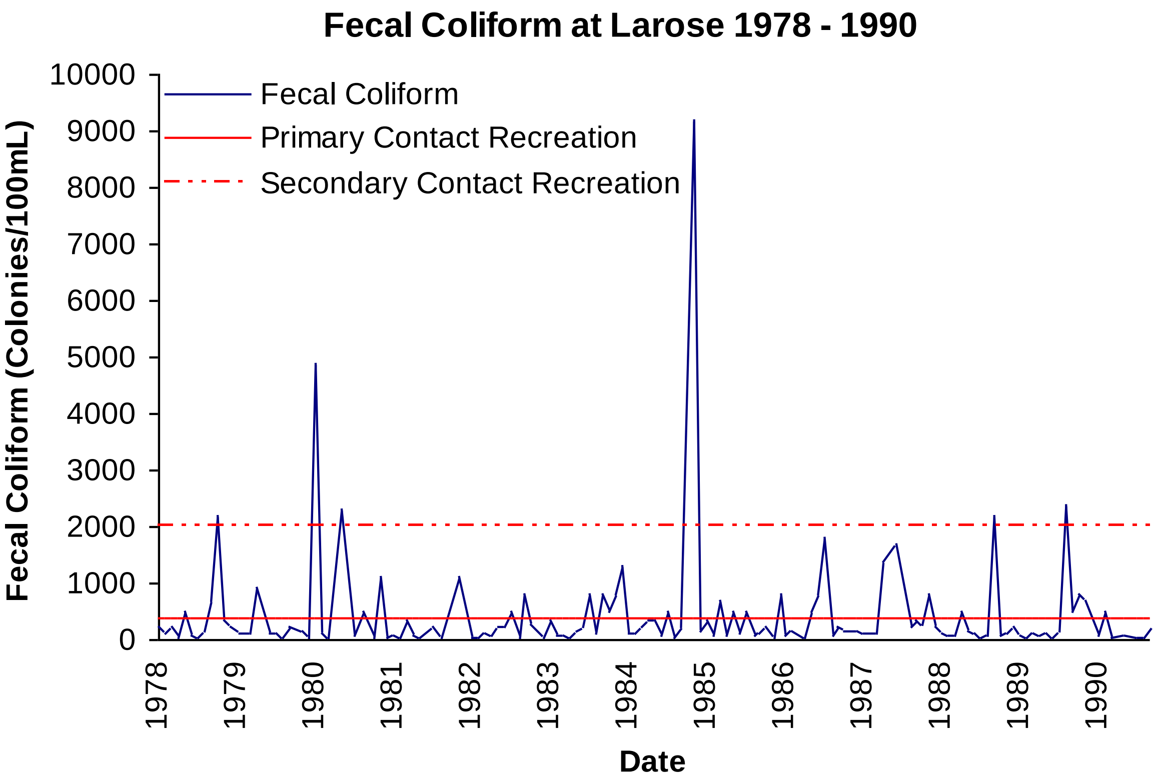

Fecal Coliform at Thibodaux 1991 - 2006
Fecal Coliform (Colonies/100mL)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Fecal Coliform
Primary Contact Recreation
Secondary Contact Recreation
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Date



Fecal Coliform at Raceland 1978 - 1998
Fecal Coliform (Colonies/100mL)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Fecal Coliform
Primary Contact Recreation
Secondary Contact Recreation
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
Date



Fecal Coliform at Lockport 1991 - 1998
Fecal Coliform (Colonies/100mL)
2500
2000
1500
1000
500
0
Fecal Coliform
Primary Contact Recreation
Secondary Contact Recreation
Feb 91
Aug 91
Feb 92
Aug 92
Feb 93
Aug 93
Feb 94
Aug 94
Feb 95
Aug 95
Feb 96
Aug 96
Feb 97
Aug 97
Feb 98
Date



The chart below shows distinct fecal coliform concentration variability over the course of two years, indicating that variability is not seasonal.